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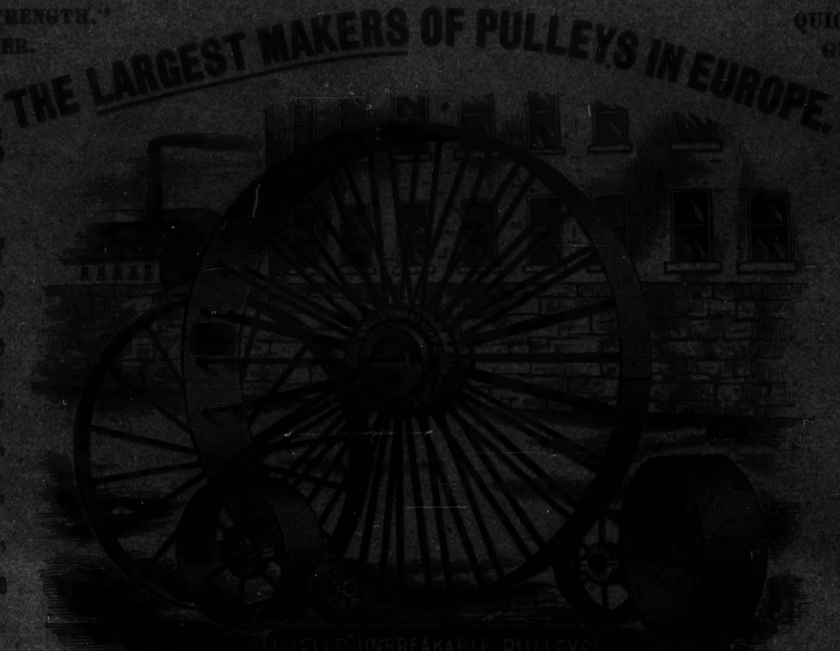
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THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XXI.—NO. 526.

# ELECTRIC BLOCK-SIGNALLING AND THE CHEVINGTON RAILWAY ACCIDENT.

THE Board of Trade report on the accident which occurred at Chevington Station on the North-Eastern Railway, on the 25th of October, has just been issued. This accident is one of those which forcibly illustrates the necessity, where the block system is in operation, of adhering strictly to the principles of that system.

On the date named an up-passenger train from Amble arrived at Chevington, and was, after performing its work, placed in the siding on the down-side to await the down main line train from Newcastle to Alnwick. Later on a special down goods and cattle train arrived and was shunted on to the up-line to clear the way for the down passenger train. In this train there were two cattle trucks for Amble and one for Chevington, and after coming to a stand opposite the up-platform the engine was detached, the cattle truck for Chevington was placed in a siding, and the engine sent forward on the up-line to clear the cross-over road points, leaving the train on the up-line.

The down passenger train for Alnwick arrived and departed in due course; and immediately thereon the Amble train came out of the siding to the down-platform and was loaded. It was then drawn forward past the points of a cross-over road, through which it was pushed on to the up-line and back to the cattle trucks which it had to pick up. At this time an up-express goods train had been accepted from Amble Junction, and was actually past that signal post and approaching Chevington.

When the two cattle trucks had been attached to the tail of the Amble train, it was started to recross on to the down line, but it had only moved forward some 12 yards when the up-express goods train, running at a speed of over 20 miles an hour, struck the detached engine, which was standing under the protection of the up home signal, and drove it back about 65 yards on to the engine of the Amble train, the tail of which train came into collision with the cattle trucks some 10 or 12 yards behind.

The evidence goes to show that the signals were against the up-goods. Of this there appears to be no doubt, and the driver of that train—who appears to have borne an unexceptionable character, having passed some 22 years in the service of the company without a single entry against him, and who is regarded as one of the best drivers on the line—explains his apparent disregard of the signals by pointing out that when approaching Chevington he was engaged in attending to the injector of his engine, whilst his fireman was breaking up coal in the tender. The driver passed the distant signal without noticing it, and was within 50 yards of the home signal ere he observed that it was on against him.

Major Marindin reports: "It is clear that the collision was due, principally, to the want of proper care on the part of the driver of the up-express goods train, who should not only have, himself, been keeping a better look out for the Chevington distant signal, but who should also have seen that his fireman was not so occupied as to be prevented from looking out for signals." He, however, considers that the responsibility for the collision does not rest solely upon the driver. Numerous other irregularities appear to have existed. With these we have little to do, beyond referring to that which very properly takes the foremost place in the list of causes contributory to the accident, viz., the method of working the traffic under the block.

With respect to this Major Marindin says:—"I do not consider that the safety of this line is sufficiently secured by the existing rules for block working, under which when goods trains only are affected, precisely the same 'line clear' is given when shunting is going on at a station, or when a train is standing just inside the home signal, as when the line is absolutely clear for some distance ahead, so that really the only protection is the strict observance of the fixed signals. I am strongly of opinion that whenever the line at a station is occupied by a goods train, a second goods train should not be allowed to pass the block signal cabin to the rear, except it be stopped and cautioned, as is already the practice upon some railways."

These observations are further strengthened by attention being called to the fact that under such circumstances not only has the danger which attends the men in the goods trains to be taken into account, "but also the possible risk to a passenger train on the parallel line, which is almost always fouled by a collision between goods trains."

The block system prescribes that trains shall be by its means kept apart a given space, but when a train is standing under the protection of the signal post which marks the line of division between the one section and the next, if a following train is allowed to enter without special caution into that section, it is evident all must depend upon the care and watchfulness of the driver of that train. The signals are there and it is his duty to obey them, and as a rule he does so. In the present case we have a man, apparently with a spotless character, having been twenty-two years without a record against him, and yet in the end he fails. If this is so with such a man, it clearly shows the necessity of trusting to something more than the fallibility of one individual. The suggestion made by Major Marindin is, with the signals arranged as at present, that which is most calculated to obtain freedom from such disasters. Few, we are sure, will doubt the propriety of observing the same rules for the regulation of the goods traffic as are in force for passenger trains. In former days, from which period no doubt the regulation making an exception in regard to goods traffic was handed down, there were no express goods; goods trains were then all alike, all travelling at a moderate jog-trot speed, and within easy control; but now we have express cattle, goods, perishable, and other trains running between distant points, without stoppage and at express speed, almost, if not quite, equal to that of fast passenger trains. The conditions are not the same, and these facts should not escape the notice of our railway traffic managers. Exceptions are always objectionable, but perhaps in no case more so than in railway working, and we very sincerely hope that in this case those companies, whose block regulations still admit of such, will see sufficient cause to modify them in accordance with Major Marindin's recommendation.

ONLY so short a time since as the middle of last month, we drew attention to the frequent failures of the electric light in St. James's Hall. Another instance of the kind occurred on Thursday evening last week during the initial stage of one of Novello's oratorio concerts, and it was only when the performance was nearly at an end that the lighting was re-established. Luckily gas has not been abandoned, and the light from the turned down jets was just enough to avert what might have resulted in a mild panic but for the action of a few gentlemen, doubtless *habitués* of the place and therefore used to the vagaries of the transformer system, who immediately commenced a loud hand-clapping. What can be the cause of these too frequently recurring failures? Does the insulation of the leads fail, or may the breakdown be attributed to the melting of the main fuses? The latter is probably correct, as the lamps were thought to be extra brilliant at the commencement of the evening. Whatever may be the reason, it is certainly time that some effectual remedies should be provided by the contractors for the electrical supply, unless we are to see St. James's Hall again not only lighted but uncomfortably heated with gas. We were led to believe that after the withdrawal of the Gaulard-Gibbs apparatus from the Grosvenor Gallery system everything would progress smoothly, but if these hitches occur in a comparatively small installation, what may we not expect in the gigantic schemes which are said to be in course of completion?

WE were informed the other evening by a gentleman who above all others ought to know what is going on in the electric lighting world, that work was now very brisk, so much so indeed that he had never been so hardly pressed in all his experience. We hope this may be the real state of the case and that depression may shortly exist in name only in the electrical trades.

IT has hitherto been the custom with some of our contemporaries to give, about the beginning of each year, a *résumé* of the work done by electrical firms during the preceding 12 months. This may or may not be very gratifying to a limited class of readers, but after all it is simply a reproduction of that which they, and everyone else who chooses to watch events, already know. It appears to us that it would be much more interesting to all concerned in the development of the various electrical industries if the leading firms would give a programme of what they are engaged upon for the ensuing year and the prospects they can foresee. Naturally we do not expect information to be volunteered which it is desirable to keep private, but much might be done to give an increased confidence in future events to both contractors and the public. The suggestion will be taken for what it is worth.

IT may not be uninteresting to our readers to learn that in October last the price of copper (Chile bars) was £41 to £42 per ton. At the end of the same month, owing partly to the scarcity of stock, but mainly to the action of speculators, prices began rapidly to advance from day to day by leaps and bounds, and it had, at the beginning of this week, reached £81 to £82 per ton, an increase of £40 in about seven weeks. The syndicate of speculators, whose operations have brought about this advance, are confident that they will be able to force prices up to £100 per ton for Chile bars. The serious fire at the Hecla and Calumet mines, which has checked a large output of copper, is also strongly in favour of the maintenance of high prices. High conductivity wire reached its lowest price, 6¾d. per lb. in October last; on Monday it was quoted at 11½d., 0 to 20. In our Notes columns the figures which have ruled during the last 10 years may be found.

ANOTHER primary battery is spoken of which leaves everything of its kind far in the rear. A copy of a certificate, signed by Frederic Prince, and purporting to give particulars of a Mr. Disher's battery, contains the following wonderful data:—Three cells have been installed in Mr. Prince's office, working continuously night and day for a whole fortnight, lighting a 6-volt lamp. The battery started at about 6·1 volts and 14 ampères. At the end of the first 50 hours there was but little change; after 100 hours the E.M.F. read 5·8 volts and the current 12 ampères; 150 hours, E.M.F., 5·5 volts, current 11 ampères; 200 hours, E.M.F., 5·2 volts, current 9·5 ampères; 250 hours, E.M.F., 5·1 volts, current 9 ampères; 300 hours, E.M.F., 5·1 volts, current 8·34 ampères; 336 hours, E.M.F., 5 volts, current 3·75 ampères. We are informed that the cells each hold half a gallon of a solution which, we believe, contains the secret of this enormous output. The electrodes also form a "new departure." It is pretty evident, however, to those people who know within a small fraction the resistance of a 6-volt lamp that there is a discrepancy somewhere, and it seems more than probable that Mr. Prince has been reading from an ammeter whose divisions represent tenths of ampères, and that for 14 we should really write 1·4. Even then, however, the length of time the cells were said to be kept in continuous operation does not reconcile itself with what we know of the performances of the best voltaic combinations hitherto devised. More light is required to be thrown upon Mr. Disher's invention before the figures we have quoted, even when divided by ten, can be accepted.

IT is proposed to form a company for the purpose of acquiring the patent rights of Jensen's electric bell and signal system for Great Britain and its dependencies, and to further develop the business of Messrs. Jensen. The bell has been described in our columns, and we have also commented upon the published reports of Dr. Hopkinson and others who cite certain points in the Jensen system as being new, whereas several so-called novelties have been known for many years to electric bell manufacturers; this, however, is of little consequence. There are several arguments advanced in the prospectus which do not appeal to us favourably, notably one in which attention is drawn to the large return which will be made by granting licenses to manufacturers in different parts of the country, who will supply their respective districts and pay royalties to the company. We do not quite comprehend how it is possible to grant licenses of this kind throughout the country, and to carry on a manufacturing business at the same time. If customers can be supplied by local manufacturers they will not trouble the company, whose operations would thus be limited to the selling of the foreign patents, receiving royalties, and perhaps supplying European markets. This portion of the prospectus is modelled too closely on the lines of the parent "Brush" Company to give undivided satisfaction. The capital of the Jensen Electric Bell and Signal Company is £100,000 in £1 shares, and the purchase consideration of the business, patents, &c., is £30,000, one half being in fully paid shares, a sum which appears extravagant enough in all conscience, and savours too much of a primary battery boom. Still, the directors have such faith in the undertaking that they have agreed to accept no remuneration until the shareholders have received a dividend of at least 10 per cent. The Jensen bell is a good thing, but it must be borne in mind that the Abdank-Deprez magnetic bell and signal system may yet compete with it, and the business, which can only be comparatively small in itself, is saddled with a big capital. Mr. Hans Jensen has agreed to act as manager for a period of seven years, so perhaps, if properly managed, the company may eventually become a source of profit to its supporters.

THE new President of the Society of Telegraph Engineers and Electricians will, we think, satisfy even those who cavil, with some degree of reason, at the inner working of the Society. Mr. Graves will doubtless try to institute such desirable and necessary reforms as will meet the views of nearly all, and as he is known to be free from any party bias his year of presidency should have a very salutary effect. As treasurer he has already done good service, and the successful financial condition of the Society is, we believe, in no small degree due to his sound and business-like policy. Altogether, we hope the date of his election may prove a red-letter day in the proceedings of the Society of Telegraph-Engineers and Electricians.

LAST week we spoke of the "Sun" portable electric lamp, whose properties were so lucidly described in the *Times*. To-day we would suggest to those of our readers who are fond of instituting comparisons, odious or otherwise, that they should read side by side the specifications granted, respectively, to G. G. Skrivanow, No. 4,460, dated 19th September, 1882, and to the New Portable Electric Lamp and Power Syndicate Company, David Urquhart and Benjamin Nicholson, No. 7,506, and dated 23rd May, 1887. We have no desire to make any comments upon the similarity of the devices employed in two specifications separated by a period of nearly five years, but it is at least advisable to put those of our readers who may not be able or in a position to go deeply into primary battery schemes upon their guard, lest some cunningly concocted article or advertisement may at some time or another tempt them into a speculation which will bring repentance in its train.

The letter of a correspondent calls attention to a matter which must have been slumbering in the minds of many persons who have not had the courage or the inclination to give it publicity. We refer to the "electric belt" panacea which is calculated to cure all the ills to which flesh is heir. We would advise "A Poor Victim," assuming that the belt has been returned to him, to have its capabilities thoroughly tested, and then, if it proves to be other than what the vendor states, he can surely seek his remedy in a court of law. Perhaps Mr. Lynd can throw a glimmer of light upon the operations of some so-called medical electricians?

IT seems almost incredible that the scenes which are said to have been enacted upon the dispersal of the guests who attended the *conversazione* of the Society of Telegraph-Engineers and Electricians could possibly have happened. The fight for hats, coats, &c., simply beggars description, and it is little short of disgraceful that gentlemen should have been submitted to serious inconveniences which might have easily been avoided by judicious management, although in a letter which we have received, written on behalf of the late President, it is urged that the arrangements were similar to those for a past year. The only similar occurrence we can recall was at the Crystal Palace on the occasion of the visit of the Sultan, but then the visitors outnumbered those attending the Society's meeting in the proportion of 30 to 1.

MR. T. R. WESTON, of Bristol, presents us with his compliments, and begs to draw our attention to his patent for lighting trains by electricity. This gentleman, much to his own disadvantage, has evidently kept himself quite in the dark concerning the variety of methods now in use, or which have been proposed, for a similar purpose. When we say that the patentee claims that the working cost is nothing, and that the electricity obtained by his patent may be used for any other purpose, our readers will at once see that Mr. Weston is a man of no ordinary mould, and the following lucid description of his apparatus, faithfully copied from a printed circular, will no doubt bring him in return a most voluminous correspondence from a whole host of persons who will feel desirous of controlling such a valuable invention: "The means by which the electricity is obtained is by friction caused by using brushes or bars in the usual manner and construction of an ordinary dynamo-electric machine, which in its construction, can be adapted to be fixed on the carriage axle of any vehicle, engine or carriage, and driven by the axle of the wheels or attached to the wheel or wheels themselves of a locomotive engine, train, or other vehicle when in motion, is the power produced for driving a dynamo-electric machine or to collect the current from a revolving armature which is fixed preferably on the underside of an engine, carriage, or any other vehicle which consists in working an electro magnet to rotate between the poles of a fixed electro magnet or coils of wire, with or without any case, and reversing the current of the internal magnet at each point when its lines correspond to the lines of the outside coils; the revolving magnet with its coils would form a disc, the current entering the coils of the rotating magnet are made to spend their inductive effect in increasing the magnetism of the outer coil, which greatly facilitates the efficiency of the motor."

# PRACTICAL ELECTRICAL MEASUREMENT.

By J. SWINBURNE.

(*Continued from page 605.*)

## *Alternating Currents—continued.*

The next thing the engineer in charge of the installation requires to measure is the electromotive force as far as the question of leakage and breaking down of insulation is concerned. For this purpose very exact measurements are unnecessary. The insulation is, of course, most likely to give way when the electromotive force is highest, so it is not a question of the mean square or virtual electromotive force, but of the highest electromotive force to which the insulation is subjected. This may be taken roughly as twenty-five per cent. more than the virtual electromotive force. It does not follow that cable, whose insulation will not permanently resist 1,000 volts from a direct current machine, will break down with 1,000 volts virtual electromotive force from an alternating machine. Insulation seems to break down from some sort of electrolysis, and with an alternating electromotive force it is probable that any harm done when the current is in one direction, is undone again when it is in the other. Leaks can be tested for with an alternating current voltmeter in the same way as in the case of direct currents. As the current through a leak does not vary as the electromotive force on it, this will not give the insulation of the circuit exactly in megohms; but this is a matter of little importance. Practically, all that is wanted is to know if the insulation is good, indifferent, or bad. The current due to the capacity of the system must not be forgotten. The capacity of a system is probably too small to have any appreciable effect. A microfarad condenser takes a large number of plates close together; but if the capacity of a system was one-hundredth of a microfarad, the leakage test would be of no use. The capacity error can be avoided by taking two readings. One of these is taken from one terminal to earth and another from the other terminal to earth. As the capacities of the sides are probably the same, the reading should be the same if there is no leak. Such readings should be taken from day to day. If there is a leak the readings are modified. On one side the instrument is in shunt to the leak, and on the other in series with it, so that a rough idea of its magnitude can be got.

The product of the virtual current by the resistance of the lead gives the power spent on it as resistance. To find the loss of power in leads, this is not enough, as the electricity streams in the lead act on one another when the current varies, and this makes the lead act as if it had extra resistance. This apparent resistance varies and depends on the current, and on its rate of increase and decrease, or in other words, on the current curve; this can be tested by taking the power by means of a wattmeter. The lead has self-induction proper, which gives an instantaneous electromotive force, and may be considered as due to the of change of stress outside the wire, and it has this internal mutual induction of the current in every part of the cross section on every other part. The self-induction proper, due to the external stress, causes a varying opposing electromotive force, in overcoming which energy is merely stored; the internal interference with the distribution of the current causes loss of energy in heating. The wattmeter of course measures this loss of energy, but as already explained, no error is caused by the self-induction proper. The waste of power by the mutual induction of the electricity streams is perhaps more important than generally supposed. The simplest way to avoid it is to use cables which are made up of strands which are themselves made of several wires twisted together. A cable made of several solid wires twisted together, such as those generally used in direct current work, does not get over the difficulty. The twisted cable should have no core, that is to say, seven little cables should not be twisted together with one of them in the middle, but six should be twisted round a rope or other idle core. In testing for loss of power in leads the lead must not be coiled up, it must be well opened out.

There are only a few instruments available for the measurement of alternating currents, because, as already explained, the engineer wants to measure the power and the virtual electromotive force and current. The only instruments in use that will do this are the various forms of Weber's dynamometer, electrometers of various kinds, and Cardew's voltmeter. The various instruments with magnetised needles are not deflected, or are at most deflected by Foucault currents in the needles. Instruments with wrought iron in them, again, do not measure anything in particular. In America, instruments in which a soft iron core is attracted into a solenoid are largely used for alternating current work, but these really do not measure. The deflection of the index has no definite relation to the virtual current through the instrument. If the iron were very small so that it became saturated at once, such an instrument would measure something approaching the mean current through it, which would not be of any use; but even then the error due to the self-induction of the coil, and to the back electromotive force due to the magnetisation and demagnetisation of the iron core, interferes with the action of the instruments.

Probably the only accurate instrument is the electrometer. This can be used for measuring virtual electromotive force, and can be made to measure current by coupling it in shunt to a known non-inductive resistance. Profs. Ayrton and Perry have also pointed out that it can be arranged as a wattmeter. It is specially applicable for measuring high electromotive forces, as it takes no current; and as the force on the needle varies as the square of the difference of potential, it is then large enough to make a sensitive instrument. If the ordinary Thomson electrometer is used, care must be taken that the needle is set so that there is no force acting vertically on it, otherwise an error will be introduced, as pointed out by Dr. Hopkinson. The terminals should be connected with the leads through some high resistance or fuse, so that if the needle accidentally touches no harm may be done. A wet string is a doubtful resistance. It may be so great that the electrometer, which is a kind of condenser, has not time to charge. This will introduce an error like that due to self-induction in dynamometers. It is also possible that the wet string acts like an electrolyte and polarises, in which case there might be an error of about a volt in the virtual electromotive force.

Sir William Thomson has lately brought out a simple form of gravity electrometer, which is much more suitable for engineering work than the laboratory form. This has already been described in these columns. Mr. Wright's electrometer has also been mentioned in connection with high-tension direct currents.

For measuring current and power the electrometer is not so good. For measuring current, the resistance in shunt to the electrometer must be large enough to give something like 100 virtual volts, otherwise the instrument is not sufficiently sensitive to read well. The same difficulty occurs with a quadrant electrometer arranged as a wattmeter. A two-plate electrometer, such as Sir William Thomson's electrostatic voltmeter, cannot, of course, be arranged to measure power.

Quadrant electrometers are not suitable for ordinary work, because they are delicate laboratory instruments, and are not direct reading.

Of the dynamometer the Siemens form is the best known. It has the grave disadvantage of not being direct reading. The fault generally found with such instruments is that there is an error from self-induction. This is true, and with a rapidly alternating current the error may be very great. Apparently no trouble has been taken to avoid such errors. There is no reason why a dynamometer-voltmeter should not be so designed that there is no perceptible error with 10 to 15,000 alternations per minute. Such an instrument is, of course, delicate, as the force acting is small, and so the spring has to be made weak. Still it is much better to make a dynamometer with a weak spring, than to have recourse to such a troublesome instrument as a quadrant electrometer. The amount of the error due to self-induction varies with the curve of the electromotive force, and, of course, with the speed of the engine or number of alternations per minute. The error from self-induction depends on the figure of the coils, not on the number of turns. Thus, if a dynamometer wound for 100 virtual volts were re-wound to give the same reading with 50 virtual volts, the percentage error would be the same as before. The self-induction error may always be reduced by using a comparatively low resistance voltmeter, and arranging a non-inductive resistance in series with it. Changing a German silver or platinoid coil into a copper one with the same number of turns and putting an external resistance in series, as is frequently done in direct current work, will not overcome the self-induction error, because the coil has the same shape and same ampère turns as before.

As already explained, however, very accurate determinations of the virtual electromotive force are of no real use in practical work. On an installation the best method is to have a photometer, and to run a lamp at the right temperature and efficiency first with a direct current, or with an alternating current and a wattmeter, and to note the virtual electromotive force on a dynamometer-voltmeter. Afterwards, it can always be seen when the lamps are bright enough, by this calibrated instrument.

At a central station the man in charge of the engine has generally to look after the primary circuits; if he has any lamps on a transformer he can keep them right and let the primary circuit take care of itself. A little transformer is sometimes used so that a low resistance voltmeter can be used; a suggestion made by Mr. Rankin Kennedy. It is better to put the voltmeter on one of the transformers of the usual size, however, as the indications of a special little transformer might be misleading. Besides, transformers do not really regulate perfectly, and as more lights are put on in the various houses the exciting current machines have to be increased.

The wattmeter, as already explained, is the only instrument that gives any really exact information in alternating current work. It is, therefore, important that it should be as free from errors as possible. Self-induction errors can easily be avoided in such an instrument as Siemens's; all that is necessary is to make the current coil give a very strong field, so that the electromotive force coil may have very few turns, and may have these arranged so as to have no appreciable self-induction. There is also no mutual induction between the coils, so that the variation of current in the current coil does not affect the current in the electromotive force coil. There may be small errors in wattmeters for very large currents arising from the distribution of the current in the large wire or rod forming the current coil. The distribution is affected not only by the mutual induction of the electricity streams, but slightly also by the electromotive force coil.

For measuring virtual currents a dynamometer is of course accurate except when errors arise from the cause just mentioned.

Sir Wm. Thomson's current weighing instruments have been fully described in this journal. For measuring virtual electromotive forces the instruments are very convenient, and no doubt the self-induction can be made inappreciable. As wattmeters, those with one stationary coil have the objection that there is mutual induction between the coils, so that the current in the electromotive force coil is affected by the current in the current coil. Sir Wm. Thomson does not, however, describe the instrument wound as a wattmeter.

For measuring virtual currents the inventor winds the coils of cable. The use of cable prevents the current distributions from being altered by the mutual induction of the coils. In cases where there is only one turn, or even when there are only a few turns, this method does not prevent the error from the wire itself. The distribution in a rope of several solid strands is much the same as in a solid rod, so that the instantaneous force would not necessarily be the same with a rapidly changing current as with one not varying.

Dr. Fleming and Mr. Gimingham's instrument recently described at the Society of Telegraph Engineers is not intended for alternating currents, but there is no reason why it should not do just as well as other instruments. During the discussion, the writer said that in this instrument there is mutual induction between the coils, causing an error as a wattmeter; but this was a slip, there is no mutual induction between them.

Direct-reading instruments have some disadvantage in alternating work, as the co-efficient of mutual induction between the coils varies with the position of the moving coil. In a voltmeter with a weak spring and no appreciable self-induction, the mutual induction is inappreciable, too, because it must be less than the self-induction; but in a wattmeter, with a powerful current coil, there may be a small error.

Perhaps voltmeters could be made more dead-beat by coupling the coils in parallel, so that the motion of the coil slightly alters the currents, causing them to oppose the movement.

Similarly the vibrations of a voltmeter may be damped by a permanent magnet close to, or embracing, a moving part.

The Cardew voltmeter is generally supposed to measure virtual electromotive force accurately. Whether it does so or not is, however, uncertain. Its self-induction is not appreciable. The writer has roughly calculated the error due to this cause in an instrument with wire of ·0025 inch diameter and 12 feet long, doubled into three feet, the wires being a centimetre apart. With 400 alternations per second, it came to one-tenth per cent.

It does not follow that there are not other errors due to the wire rapidly heating and cooling instead of radiating and giving up its heat at a constant surface temperature. In addition to this the current distribution may not be the same as with direct currents. But as very accurate determinations of virtual electromotive force are not necessary, the Cardew is as good, if not better, than any other instrument. The same remarks apply to the new voltmeter devised by Profs. Ayrton and Perry.

The meters of Profs. Ayrton and Perry are suitable for alternating currents. The same precaution must be taken as to self-induction as with wattmeters. Mr. Ferranti has also modified his meter to make it work with alternating currents. Such an adaptation can only be made by long and laborious experiment, and even then it is doubtful if such an instrument can be made as accurate as for direct currents.

Prof. Forbes's meter has been so often described, that it is only necessary to mention it here.

(*To be continued.*)

## PRIMARY BATTERIES.

By P. SELBY.

Among other things brought out here (Sydney, New South Wales) by me nearly four years ago was an *electric pen* apparatus with a Fuller bichromate battery. The difficulty of obtaining suitable cells and zincs for replacement caused me to seek some other form of cell by which the expense and internal resistance of porous pots could be avoided. After sundry experiments with a view to narrow the matter down, I arrived at a stoneware jar containing the usual bichromate potass solution plus sulphuric acid, a piece of thin platinum wire clothed with pure black India-rubber, and a $\frac{1}{8}$th inch tube cemented to the wire at an inch from the bottom. The spare inch of wire was then made into a flat spiral capable of picking up a small quantity of mercury (fig. 1), the India-rubber tube being simply for insulation so that the platinum should not affect the result. On plunging this into the jar of solution a good current was produced for a short time; when withdrawn for examination it was found that *part* of the mercury still adhered to the platinum wire although action had ceased; a fresh dip of mercury restored the effect. On investigation I found that the mercury had been used with zinc and was in fact *an amalgam*. The absence of zinc meant absence of effect. On this result a simple and effective cell was formed. (Fig. 2.) A small jar (2 oz. Liebig's extract of meat jar) was divided off by a *glass partition* cemented in with bicycle tyre cement (more expensive than "Chatterton's," but much stronger for grooveless partitions, jointing parchment-paper cells for Leclanché's, India-rubber, gutta-percha, shellac, and bitumen) reaching *nearly* to the bottom of jar; mercury is then poured in (dotted in fig.) to form a "sealed joint" to separate the fluids; carbon on the one side of the partition (but *suspended* so as not to touch the surface of the mercury) in bichromate potass, sulphuric acid solution, and on the other side, zinc standing in the mercury in *plain water* to assist in counter-balancing the bichromate fluid on the other side so as to require less mercury to make a safe joint. Of course the jar is represented wider than is really the case so as to prevent confusion in the sketch. I was led to this form by many circumstances, among others, the peculiar way in which a zinc in bichromate battery was "undermined" where it was outwardly protected by a cement which resisted the action of the dilute acid solution in the porous pot.

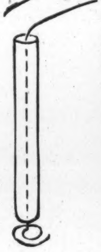


FIG. 1.

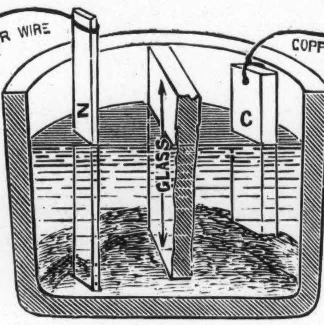


FIG. 2.

FIG. 3.

For cheapness and handiness, glass tumblers or drinking glasses with what are known as *well bottoms* (fig. 3), would make up very handy cells for experimental purposes.

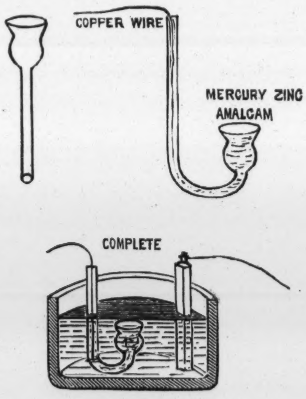


FIG. 4.

Further experiments led to a "thistle tube" of glass arrangement, the tube (fig. 4) being bent in a gas flame as shown, mercury placed therein and copper wire being passed down the stem into the mercury. This is simply placed in a jar of solution containing the carbon, but the mercury must receive occasional replenishments of small pieces of sheet zinc, which readily dissolve in it. The thistle tube is convenient for lifting in and out, and when it can be lashed to a spring clothes peg clipped on the top of the jar.

But for permanent use a small shallow pot of earthenware (such as Needham's metal polish is sold in) (fig. 5) has a round zinc rod cemented in firmly so as to form a means of lifting in a complete state out of the outer battery jar, mercury is then poured in to form a "water joint," a paraffin lamp chimney with a "crinkled" top (fig. 6) is then inverted and passed down the zinc rod into the mercury and filled with *pure water* to counterbalance the pressure of the *surrounding* fluid (bichr. potass + ac. sulph., usual solution) in which stands the carbon.

*Note.*—This water remains purely free from any acidity for months, and by careful tests I find that the addition of sulphuric acid simply weakens the battery by setting up a "counter" current. In the "porous pot form" the acid seems quite necessary to lower the resistance of the fluid, but here it is different. Of course a preferable form to avoid risk of cement giving way, would be to make the glass and the dish in one (in glass) with piercings to ensure the continuity of the body of mercury in contact with the zinc and the bichrom. ac. fluid.

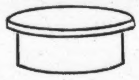
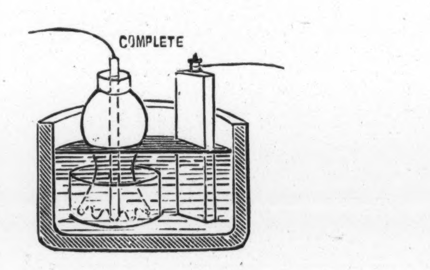
FIG. 5.


FIG. 6.



The thistle tube arrangement I do not like, owing to having to supply the zinc, and the surface of mercury is too small too, but the other arrangements I have tested for six months successfully.

## COMPOUND-WINDING DYNAMOS: BRUSH v. CROMPTON.

By S. ALFRED VARLEY.

(*Continued from page* 617.)

There is a custom which has come into being of late years which I venture to think is more honoured in the breach than the observance. It is an open secret that many if not most of the scientific specialists, who had made affidavits on behalf of the Anglo-American Brush Corporation in the late case, were specially retained long before there was any idea of the Brush patent coming under the purview of the Law Courts.

Witnesses so situated cannot be free agents. However much they may dislike it, they find themselves in honour bound to support the side which has retained them, hence the hair splittings, &c., of which we have had experience in late electrical cases.

One can understand any of our most distinguished scientists (both of the past and the present) giving evidence, but one would find it difficult to imagine such men as Faraday, the late Prof. Graham, or Clerk-Maxwell accepting positions which would involve the liability of their being called upon, and for all practical purposes compelled, to support patent rights quite irrespective of their real merits.

The scientific experts who made affidavits on behalf of the defence in the late case were not in this invidious position, and their affidavits (unlike most of those made on behalf of the plaintiffs) were drawn up independently of one another.

The witnesses for the defence included Dr. Hopkinson, Prof. W. Grylls Adams and other distinguished scientific professors, and the opinions they expressed were that my specification described a series shunt or compound-wound dynamo.

The copy from the sketch in my note-book, I venture to assert, conclusively demonstrates that my machine was intended to be a compound-wound machine from the very first, but the affidavits which were made on behalf of the defence were all of them drawn up before it was known by the defendants that I possessed the sketch.

If I left off at this stage I think I should be allowed to have proved the case I am contending for; but I proceed to quote at length the whole of that part of my specification which relates to compound winding, and then I propose to analyse it. I state at p. 8, commencing at line 38, "Part of the electricity developed in the machine is diverted to maintain the magnetism of the soft iron magnets, and the remaining portion is used to produce the electric light."

Then I go on to say: "There are several *well-known ways of doing this*, but the way I prefer is to wrap the soft iron magnets *with two insulated wires*, one having a *larger* resistance than the other. The *circuit* of *larger resistance* is *always closed*, and the circuit of less resistance is used for the electric light." The immediately following sentence reads as follows:—"When the electric light is being produced the greater portion of *electricity* passes through the circuit of less resistance, which I term the electric light circuit, maintaining the magnetism and producing the light. When the electric light circuit is opened from any cause, the electricity passes through the circuit of *greater* resistance *only* and *maintains* the magnetism of the magnets."

I would state that a point is tried to be made by the plaintiff of the word "divert," and by criticising this sentence apart from its context, which explains the sense in which I used the word divert, a certain amount of mystification is produced.

I think it must be seen, if the sentence containing the word divert be read in connection with the one immediately following it, that I was only expressing the principle of action of all self-exciting dynamos (my own included). The distinctive feature of a dynamo as contrasted with a magneto machine, as is well-known, consists in the fact that the magnetic field of a dynamo is produced by a consumption of force in the machine itself, and the percentage of energy so diverted, and therefore not available for external work, was, in the best dynamos of 1876, a *very* considerable one, and it seems almost unnecessary to state that in all dynamos, be they compound-wound, series, or shunt wound, there is a diversion of a portion of the total amount of energy consumed for producing the magnetic field.

That this was the sense in which I used the word "divert" is demonstrated by the next sentence in which I say there are several well-known ways of doing this; as I was referring to general principles I did not consider it necessary to describe the well-known methods in which this diversion of part of the energy developed was effected in the different types of dynamos.

I then proceed to describe the method which I say "I preferred," and which I considered to be an original method, and consequently an important feature of my invention, and then I state "I wrap the soft iron magnets with two insulated wires, one having a larger resistance than the other. The circuit of larger resistance is *always* closed, and the circuit of less resistance is used for the electric light."

It is clear from the description so far given that there were two circuits of unequal resistances wrapped on the soft iron cores of the field magnets, that the circuit of larger resistance was a shunt, as it was always closed, and that the circuit of less resistance was a series circuit, as the electric light or the external work was included in it and completed the circuit. It should be noted that I did not specifically mention at this place that either of these two circuits magnetised the field magnets. I assumed that it was generally known that if you wrap a soft iron core with insulated wire and send a current through it magnetism is developed; but the learned scientific experts declare, because I did not at this place actually say the electric force passing through these circuits developed magnetism, my machine was not compound-wound, for they say in a common sentence, which appears in several of the affidavits, my machine could not have been compound-wound, because "it is an essential characteristic of compound-winding that the whole of the electricity developed by the machines goes at all times to maintain the magnetism of the magnets."

The last sentence of that portion of my specification which relates to compound-winding, and demonstrates clearly the *modus operandi* and the arrangement of the two circuits in respect to the dynamo, and the external work is conveniently ignored in the plaintiffs' affidavits. In this sentence I say, "When the electric light is being produced the greater portion of the electricity (and therefore not the whole) passes through the circuit of less resistance, which I term the 'electric light circuit,'" maintaining the magnetism and producing the light. I here state the series circuit includes the electric light or the external work and the greater portion of the force passes through it, performing the external work as well as magnetising the field magnets. I then go on to say that if the series circuit is opened from any cause the magnetism is maintained *only* by the circuit of larger resistance, which I have stated in an early part of my specification is at all times closed. It is quite true I have not said in actual words that both the circuits when external work was being performed were maintaining the magnetism of the magnets, but I have stated plainly their disposition both in regard to the machine and the external work, and that each of these circuits magnetised the magnets, and therefore it is absolutely clear that the whole of the force developed by my machine maintained the magnetism of the magnets, and also, inferentially, that there was a stronger magnetic field when external work was being performed.

I would call attention to the fact already briefly referred to, that the points on which the plaintiffs rely in support of their attempted contention that my specification did not describe a system of compound-winding, occur in sentences common to most of the affidavits. This, I need hardly say, lessens the value of the affidavits made on the side of the plaintiffs most materially.

The reason this course was adopted is sufficiently obvious. It would never have done, from the plaintiff's point of view, to have followed the course adopted on the defendant's side, and to have made absolutely independent affidavits, for it was part of the necessity of the case, as far as the plaintiffs were concerned, to explain away the obvious meaning of my description, and it was necessary they should agree with one another.

It was originally my intention to analyse at some length the plaintiff's affidavits, but I refrain from doing so, for, besides wearying your readers, it would involve the necessity of my following a similar course to that which the plaintiffs have done in my case, viz., to assume that they are not acquainted with some of the most elementary facts of electro-magnetic science, such, for instance, as that magnetism is developed whenever electrical energy is transmitted through a conductor. I, therefore, propose to confine my remarks on this head to a brief, general description of the character of the affidavits made on behalf of the plaintiffs.

In these affidavits, as might be expected from professional men of such high scientific attainments, there is much valuable and interesting scientific matter, and as scientific essays on compound-winding, they are very complete; but the gist of these affidavits, so far as they relate to the points in contention, are stated in sentences common to most of the affidavits; they animadvert on the very brief description given in my specification, as well as the fact that I made no special claim for compound-winding, and both by criticising the sentences forming part of my description, separately, and conveniently ignoring their plain meaning, as shown by the context, they profess to demonstrate that my machine was not series shunt or compound-wound.

They would seem, however, to have felt that it would be presuming too much on the credulity of even an innocent judge to have assumed that I had not described a dynamo of some kind, and, therefore, they would appear to have thought it necessary to make some sort of attempt to explain how my machine was intended to be worked.

To enable them to do this they appear to have obtained the assistance of some one who evidently appreciated the scientific uses of the imagination, and who drew up the statement which forms the second chief point in the plaintiffs' affidavits, and which appears as a sentence common to most of these affidavits. In this common sentence they say my machine "was evidently intended to be a double shunt machine, and that the circuit of less resistance was presumably arranged as a shunt from the electrodes of the lamp."

I do not presume to understand how they intended me to work my machine, but I have to say there is not a single word throughout the whole of my specification to suggest such a notion, and the putting forth of such a hypothesis is evidence to my mind that the plaintiffs' side have felt themselves in a dilemma to explain away the common sense interpretation of my very plain description.

I now proceed to comment on the contrast drawn in the plaintiffs' affidavits between the descriptions of Varley's and Brush's inventions, as contained in our respective specifications.

In most, if not all, of the affidavits filed on behalf of the plaintiffs, a great point is made of the very minute and elaborate description of every detail of Brush's invention as given in the specification accompanying the patent granted in the name of Haddan, No. 2,003, 1878, and this complete description is favourably contrasted with the very brief one which is given in my specification. I claim that the plaintiffs are here "hoist with their own petard," for throughout the whole of the elaborately minute description of Brush's invention, there is no mention of self-regulation nor is there any suggestion whatever that Brush considered his machine to possess the well-known characteristic features of compound-wound machines. In my machine, as I simply described the details of construction and the arrangement of the circuits, so as to explain the *modus operandi* of the machine, it is of course open to an adverse critic to argue that I had not self-regulation in view when I designed the machine. But this line of argument is not open to the plaintiffs, seeing that the great point they contend for is that in Haddan's specification the description is so minutely complete.

I rely on the very elaborate description which is given in Haddan's specification to support my contention, that the claims now asserted by the Anglo-American Brush Corporation are untenable. Brush, it seems to me, followed a course only too well known to those who have had experience of patented inventions, viz., that of describing all sorts of possible combinations in the hope that some out of the number may be considered to cover developments made by others in the course of time, and that he might thereby be enabled to obtain a monopoly of advances, of which he was not the originator.

Before proceeding to analyse and quote from Haddan's specification to demonstrate my contention that Brush has no claim to be considered the first to have described compound winding, I think it will help to clear up matters if I here state briefly, both what I claim and what I do not claim to have done. I claim to have described compound winding; I also claim that one of the leading objects I had in view when I designed my machine was automatic self-regulation, and I have stated the reasons which led me to this in an earlier portion of the article. I confess I did not see visions of glow lamp installations, although I believed the division of the electric light would some day be proved to be practicable.

I claim to have understood the electrical consequences of the series shunt winding devised by me, and I regarded it as an altogether new departure likely to prove pregnant of further developments in the not far distant future, but I have never pretended to have prophetic visions, and I freely acknowledge I saw only through a mist. As a matter of fact it has long since become a second nature with me to keep a check on the imagination, which I regard as treacherous, for although I recognise that the imagination has its scientific uses, I consider that its legitimate use is for home consumption and never for public enunciation. I regard it as the true province of the scientist to trace the links which connect the forces and phenomena of nature one with the other rather than to generalise, and I hold it as little short of a crime to indulge publicly in scientific sensationalism, the effect of which, in the very nature of things, must be to produce in the long run a reaction detrimental to the interests of real progress.

The discovery I made that my late brother had to some extent anticipated me, combined with what I felt at the time to be the unwisdom of my partners in letting a legal property lapse, I confess took the heart out of me to a considerable extent, and I do not think I should ever have published what I consider to be my just claims in the matter of compound winding had not the Anglo-American Brush Corporation taken up the position it has done.

Perhaps, as Mr. Sellon in his published letter refers to what he has termed "Mr. Varley's well-known sense of self-abnegation," I may be allowed to say that when I first became aware of the intention to disclaim parts of Brush's patent, I called upon Mr. T. E. Gatehouse, who was better acquainted with the details of my patent than anyone else, as he had assisted me at the time the machine was being constructed, and had made the drawings for the specification; the object of my visit was to request him not to call attention to my patent nor to publish it in any way.

Mr. Beeman, previously a stranger to me, some little time later called upon me informing me that he had discovered and read my specification. I told him I was sorry he had done so, but after some conversation I informed him that I considered I had no right to ask him not to publish it if he thought it would be of any professional value to do so.

(*To be concluded.*)

## THE DEVELOPMENT OF THE MERCURIAL AIR PUMP.*

By Prof. SILVANUS P. THOMPSON, D.Sc., B.A.

(*Continued from page* 613.)

The introduction of the Sprengel form of pump at once attracted a revived attention to the advantages of mercurial pumps for exhausting, and it was soon in the hands of many experimenters. Graham † applied it to extract minute quantities of gases in his researches on gaseous diffusion; Bunsen ‡ adapted it for the purpose of hastening filtration, employing a form somewhat modified to admit of the use of drops of water instead of drops of mercury. Improvements began to be introduced in the details of construction, as experience revealed the imperfections. It was found that air was liable to be carried down into the pump through the supply vessel at such times as more mercury was poured in above; it was necessary to trap off such air bubbles to prevent them from vitiating the vacuum already attained. It was found necessary to introduce vessels containing drying materials, such as concentrated sulphuric acid, or glacial phosphoric acid. The fall tubes were found to have an awkward habit of cracking and breaking off just at a point 30 inches above the lower end, in consequence of the hammering action of the falling drops during the later stages of exhaustion. Better and more reliable gauges were required to verify the degree of rarefaction. Lastly, some remedy was wanted for the difficulty experienced in forcing down through the 30 inches of barometric column the last small traces of residual air in the fall tube. The falling drops hammered these residual bubbles into the mercurial column below them: the air bubbles, on their part, always tended to rise again into the upper part of the tube; often they would stick to the wall of the glass tube, refusing to move, though the mercury continued to flow past them. The remedy of turning on a more sudden flow of mercury to sweep them out was not always successful. Indeed, when it is remembered that these last residua must be recompressed to atmospheric pressure, in order to expel them at the bottom of the tube, it would seem strange if such a method of expelling the residual air should prove effectual. Some of the desired improvements were originated by Dr. Sprengel himself, others by instrument makers, who constructed Sprengel pumps for their customers.

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* Read before the Society of Arts, Wednesday, November 23rd.

† Graham. "Journ. Chem. Soc.," xx., 247, 1866. See also "Pogg. Ann.," cxxix., 563, 1866.

‡ Bunsen. "Ann. Chem. Pharm.," cxlviii., 277, 1868. See also "Ann. Chem. Pharm.," clxv., 159; and "Phil. Mag.," xlv., 153, February, 1873. Compare also with water pump of M. W. Johnson, "Chem. Soc. Quart. Journal," 1852, p. 186.

An improved joint, made by grinding the conical end of a glass tube into a conical socket at the end of another tube, and placing mercury in the cup surrounding the junction, was described by Dr. Sprengel.

By the year 1874* two modifications had come into extensive use; the mercury, instead of running direct into the pump from the supply vessel, was carried down a vertical tube, surrounded by a wider external one, so that any air bubbles accidentally carried down escaped up the wider tube instead of entering the pump; also after passing this trap, the mercury was forced up again in moderately wide tube, ascending to a slightly lower level than the supply vessel, and again descending. The upper bend of this tube communicated at its highest point with a small stoppered chamber, partially exhausted of air by filling it with mercury, which was then allowed to run out. As the mercury passed over this bend, it consequently fell through a partially exhausted space, and was still more thoroughly freed from air before ascending to the head of the actual pump. These improvements are embodied along with others in the form constructed by Alvergniat,† of Paris, who worked for and with the advice of M. H. Sainte-Clare Deville.

In most of the modern Sprengel pumps the mercury is introduced into the pump head by a jet tube with a narrow orifice, whence it spurts in a fine stream, and falls into the widened tube of the fall tube; in some other forms it merely breaks away in drops over a bend in a wider tube. This form is simpler to construct.

A very important addition was the improved gauge introduced by McLeod,‡ in which was applied the principle of compressing a known volume of the rarefied air or gas into a smaller known volume (the ratio of the two volumes being accurately known) and then measuring its pressure, and so calculating backwards. This method, suggested long before by Arago, and employed by Régnault § for the purpose of testing the perfection of the vacuum of a barometer, may be regarded as a refinement upon the method of the "pear gauge" invented by Smeaton. In Smeaton's invention the residual air left in the pear-shaped glass vessel, placed with its lower end in mercury, under the receiver of an air pump was, on the restoration of the external pressure, driven out of the body of the pear into its narrow upper end, where its volume could readily be measured. In McLeod's original gauge a globe of about 48 cubic centimetres was employed, opening at the top into a narrow volume tube sealed at the top, and suitably graduated. This apparatus communicated below with the pump, and stood at the top of a barometric column which was provided at its foot with a flexible rubber tube and a supply vessel, by raising which (by an action like that of Geissler's pump) the mercury could flow up into the gauge, and force the residual air in the bulb into the volume tube at the top. A neighbouring pressure tube rendered the increment of pressure (due to compression) evident at a glance, and all that remained to be done was to multiply this increment by the ratio between the volume now occupied by the residual air and volume it originally occupied. McLeod showed how to carry the calculation to a second approximation.

About the same time Crookes || introduced several improvements in detail:—A method of lowering the supply vessel to refill it with the mercury that had run through the pump; the use of taps made wholly of platinum to ensure tightness; the use of a spark gauge to test the perfection of the vacuum by observing the nature of an electric spark in it; the use of an air trap in the tube leading up to the pump head; the method of connecting the pump with the object to be exhausted, by means of a thin, flexible, spiral glass tube; the method of cleansing the fall tube by letting in a little strong sulphuric acid through a stoppered valve in the head of the pump. In carrying out these experiments, Crookes was assisted by Mr. Gimingham, whose further contributions to the development of the pump will presently be noticed. It was with this improved pattern of Sprengel that Crookes was able to carry out that remarkable series of researches upon the repulsion accompanying radiation, which culminated, in 1875, in the invention of the radiometer, and later led to the discovery of the phenomena of "radiant matter."

Prof. R. A. Mees * described another modification, the fall tube being constructed with a series of bends constituting fluid valves or traps, in which the minute portions of air carried down the fall tube might accumulate in order to be swept out the more effectually when aggregated in larger bubbles. This pump also had a peculiar automatic stop cock.

From 1875 to 1884 a series of modifications were introduced by Mr. Gimingham.† Firstly, the process of exhaustion was accelerated by the employment of multiple fall tubes, receiving their streams from a distributing jet within the pump head. Three fall tubes were employed, then five, later seven; but five appears to be a preferable number. In fig. 23, which embodies Gimingham's various improvements with the earlier ones of Crookes, there are five fall tubes shown. Careful experiments to determine the best size of bore for the fall tubes gave the following results when exhausting a vessel of 136 cubic centimes capacity:—

| Diameter of bore in millimetres. | Rate of flow in cubic centimetres per minute. | Total quantity of mercury in cubic centimetres requisite to reduce pressure to one millimetre of mercury. | Total time required in minutes. |
|---|---|---|---|
| 2·4 | 83·3 | 2,500 | 30 |
| 2·4 | 20 | 1,600 | 80 |
| 1·8 | 20 | 700 | 35 |
| 1·8 | 50 | 1,200 | 24 |
| 1·4 | 10 | 1,800 | 180 |
| 1·4 | 25 | 2,700 | 120 |
| 1·1 | 20 | 4,000 | 200 |

The enormous time required in the last case was due to incessant choking up of the upper part of the fall tube, owing to friction in the narrow bore. The conclusion derived from comparison of results with varying bores is that at high degrees of exhaustion the last portions of air or gas are carried out by entanglement with the mercury, and not by the mercury acting in definite "pistons" to sweep out the gas. With respect to the length of the fall tubes, it was found that those 39 inches (1 metre) long, giving a fall of 9 inches (or 22·5 centimetres), exhausted more rapidly than tubes only 33 inches (85 centimetres) long. Tubes longer than 39 inches were found liable to fracture, in consequence of the severe concussions of the mercury as it fell upon the top of the barometric column. Gimingham also described an improvement in the McLeod gauge, making its indications at once more sensitive and more reliable. Several minor improvements are also mentioned; an improved vacuum tap, an improved form of air trap, a radiometer gauge, and a bulb containing crumpled gold leaf, to absorb mercury vapour.

The lettering in fig. 23, which is taken from Gimingham's paper in the "Journal of the Society of Chemical Industry," is as follows. The supply vessel, A, communicates by a long tube with a forked tube, C, leading to two regulating pinch cocks, *r* and *q*. The left-hand tube leads up through two air taps, *n* and *m*, to the McLeod gauge; the right-hand tube, through two air taps, *n* and *i*, to the pump head, where the mercury is thrown in jets into the tops of the five fall tubes. The tube, *t*, is the exhaust tube, which has three branches, one, *s*, leading to the McLeod gauge, one, *l*, leading to the barometric gauge, *u*, and one leading through the drying tube, *x*, and the absorbing tube, *y*, to vessel, lamp, or bulb, which is to be exhausted. A comparison barometer is placed at *v*, and a measuring rod to read off barometric heights is fixed at *w*. The arrangements at *d*, *e*, *f*, and *g*, relate to a mechanical method of counting the number of times that the supply vessel has been let down to be replenished.

Mr. Gimingham has also suggested ‡ a mechanical mercurial pump with valves.

A five-fall Sprengel pump, of simpler construction, and jointed with India-rubber tube joints, is used by the Thomson-Houston Company, in their factory at Lynn, Massachusetts. The Anglo-American (Brush) Company have also used a modified five-fall tube in their works at Lambeth. Another multiple fall pump has been patented by Mr. Donkin.§

Dr. L. von Babo || described an ingenious method of making the Sprengel pump supply itself with mercury, by the device of connecting it to a water aspirator, worked by a constant stream of water. This aspirator drew in air and mercury at the lower part of the pump, and lifted it up through a narrow tube to a height above the level of the mercury in the supply vessel. Incidentally, this method has the advantage, apparently not noticed by von Babo, of enabling the fall tube to be considerably shortened; it has the disadvantage of exposing the mercury to water vapour during a part of its circulation.

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* See E. J. Osmond in "English Mechanic," xix., 372, 1874, giving drawing of Sprengel pump.

† Alvergniat's form is depicted in Violle's "Cours de Physique" (1884), I., 947. The form commonly used in Germany is given in Weinhold's "Physikalische Demonstrationen" (1881), 171.

‡ McLeod. See "Phil. Mag." (4) xlviii. 110, 1874, and "Proc. Phys Soc. Lond." i. 30, 1874.

§ Régnault. "Rélation des Expériences" (1847) i. 491.

|| Crookes. "Proc. Roy. Soc.," xxxi., 448, 1881; also "Proc Phys. Soc. Lond., i., 35, 1874.

* Mees. See "Catalogue of Loan Collection of Scientific Apparatus," 1876, p. 131.

† Gimingham. "On a new form of the Sprengel Air Pump." "Proc. Roy. Soc.," clxxvi., 396, 1876; and "Contributions to Development of Sprengel Air Pump." "Journ. Soc. Chem. Indust.," 1884.

‡ Gimingham. See "English Mechanic," xxxvi.," 442, 1882.

§ Donkin. Centralblatt für Optik und Mechanik, vii, 216, 1866.

|| Von Babo. "Berichten d. naturforsch Gesellsch zu Freiburg." ii., Heft. 3, 1879.

Macaluso[*] proposed the addition of a Mariotte's flask, to regulate the flow of mercury, thereby avoiding the need of having a movable reservoir.

Rood,[†] in 1880, described several details of some novelty; an iron valve in the bottom of the supply vessel, capable of fine regulation by a screw, served to determine the rate of flow of the mercury. Immediately below the supply vessel, the mercury entered a vacuum bulb (see fig. 24), designed to free the mercury from air and moisture, the mercury dropping at once to its lower part, which should be level with the point where the curved supply tube joins the fall tube. This bent tube, about 20 centimetres long, after descending gently, ascends about 4·5 centimetres; it is made of about the same diameter in the fall tube. The fall tube, as in Mees's pump, is provided with bends. Rood also described a modification of the McLeod gauge. His pump was so mounted that all parts of it could be heated by means of a Bunsen burner. Great importance was attached by this experimenter to this point; as it appeared that much higher exhaustion was thereby attained.

FIG. 23.—GIMINGHAM'S PUMP.

In 1882, Hannay[*] proposed to replace the mercury by a fusible alloy of lead, bismuth, and tin, melting at 94°; by this means it was thought that the necessary imperfections arising from the pressure of mercury vapour would be avoided.

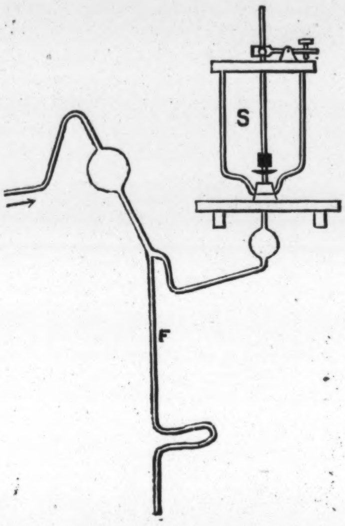

FIG. 24.—ROOD'S PUMP.

The Sprengel pump employed by the Edison Company (New York, 1885) in the manufacture of glow lamps, has a simple fall tube cemented (as shown in fig. 25) at its lower end into an iron tube, E, which carries away the ejected air and mercury from a series of such pumps. An iron supply pipe overhead feeds the pumps. Strong sulphuric acid placed in a shallow glass vessel, D, is used for drying.

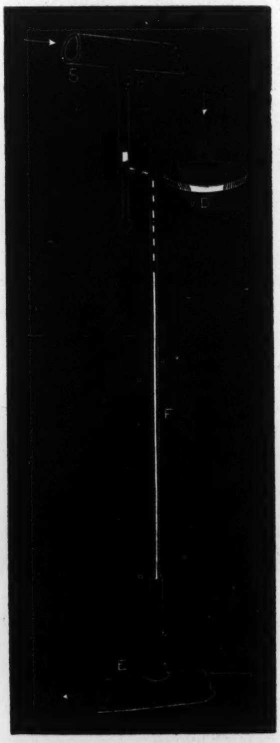

FIG. 25.—EDISON PUMP (1885).

*(To be continued.)*

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[*] Macaluso. See "Wied. Beibl," iv., 516, 1880.

[†] O. N. Rood. "Sillim. Journ.," xx., 57, 1880; *i.b.* xxii., 90 1881. See also *New York Times*, November 19, 1880.

[*] Hannay. "Philos. Magaz." [5] xiii., 229, 1882.

# ON PHOTOMETRY OF THE GLOW LAMP.*

By Captain ABNEY, R.E., F.R.S., and Major-General FESTING, R.E., F.R.S.

*(Concluded from page* 610.)

Mr. W. H. Preece, in his paper † already alluded to, came to the conclusion that the intensity of the light emitted from a glow lamp varied as the sixth power of the current. This formula is fairly exact within limits, but it is obviously empyric, since where the current is small enough only to cause dark radiation it must fail. The example that he gives would require some slight rectification before it can be used as in the method given above; since the small distances at which the candle he employed was placed from the screen makes it necessary to apply corrections for the thickness and length of flame.

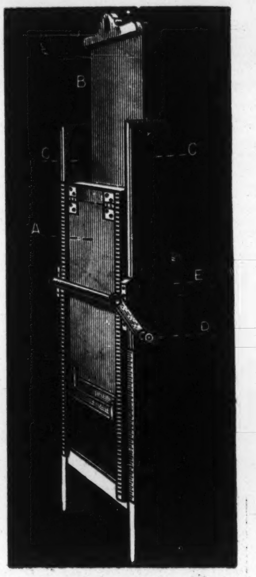

FIG. 4.

Mr. Preece's table (V), is given here; the last column is derived from the parabolic formula using $c^2 - s$ instead of $w - m = a \sqrt{y}$.

TABLE V.

| Distance of source of light from illuminated surface. | Equivalent degree of illumination. | Current in ampères. | $C^6 \times 15{\cdot}994$. | Parabolic formula. |
|---|---|---|---|---|
| 0·50 feet | 64·000 | 1·260 | 64·000 | 64·00 |
| 0·75 ,, | 28·445 | 1·100 | 28·335 | 32·83 |
| 1·00 ,, | 16·000 | 0·959 | 12·442 | 16·00 |
| 2·00 ,, | 4·000 | 0·790 | 3·888 | 4·41 |
| 3·00 ,, | 1·778 | 0·690 | 1·726 | 1·78 |
| 4·00 ,, | 1·000 | 0·651 | 1·217 | 1·00 |

It having been shown that the parabolic formula applies to visual measures of an incandescence light, it appeared that the same ought to hold good for the total light which is photographically active. These rays may be taken to lie between the blue and the extreme ultra-violet of the spectrum, and consequently the vertex of the parabola should lie further towards the blue of the spectrum than it does with the visual rays. The method of testing was as follows :—

An ordinary dark slide, A, carrying a sensitive plate, was placed in grooves, C, C, attached to a board, D, against which the slide (when its front, B, was drawn out) could be raised or lowered as occasion required by means of a rack and pinion motion working by the handle, D.

E is a projection in which a slot, H, is cut, and through which a card having a square aperture, K, can slide. K can be covered by means of a cardboard square. The bottom of the plate in A is first brought opposite the aperture, K, which is placed opposite the number marked 1 on E. The lamp is placed 4 feet away, the volts and ampères noted, and exposure is given to the small square of the plate seen through the square in K for any time which may be fixed upon. The slide, A, is lowered ¾ inch (K being covered up) a different current passed through the lamp, and another exposure given, and so on. When the top of the plate has been arrived at by the motion of A, the card, F, is moved till K is opposite 2, and the same procedure repeated. Six to seven exposures can be made in the same row.

When the second row is exhausted, K is placed opposite 3, and such a current is passed through the lamp that it emits a medium light. A scale is then made by giving different lengths of exposure at each alteration in the last half of the plate. The plate is then taken out of the slide, and the images developed. By this means both a time scale, and a measure of intensity for different temperatures are on the same plate in the shape of squares of different density of deposit. When the negative is dry it is placed in an apparatus which works on the principle of the optical lantern, and is described in the paper written by one of us, "Atmospheric Absorption of Sunlight" ("Phil. Trans.," 1887) and the density of each square measured. The "intensity" measures are then compared with the time scale, and the value of the intensity calculated. From these values it can be determined if the curve of intensity and watts increases parabolically. It might be objected that increase in intensity is not convertible into "time of exposure." Careful experiments have been made as to this, and for the range of time which is comprised in the seconds of exposure given no appreciable error ensues.

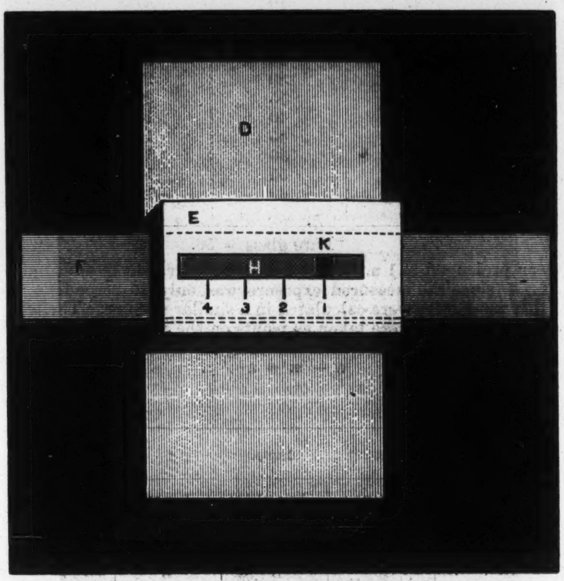

FIG. 5.

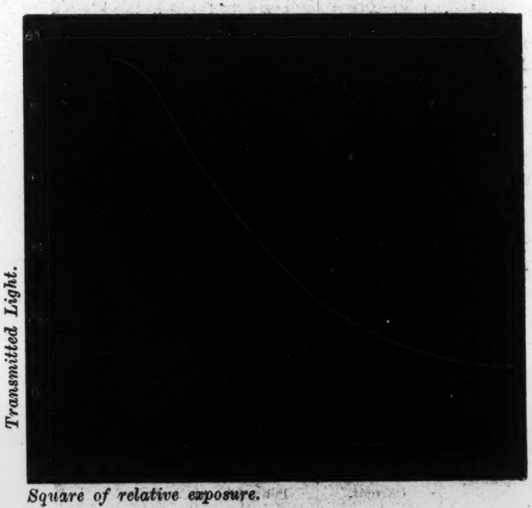

FIG. 6.

Table VI. is an example of an experiment conducted in the above manner.

It may be well to point out exactly how the above table was devised. From the time scale table the diagram, fig. 4 (on large dimensions) was constructed. Take Nos. 1 and 2—the exposures given to each were the same, viz., 15 seconds. The light transmitted through each square was read off, and found to be identical, viz., 21·5, In the scale diagram the abscissa of the curve having the ordinate 21·5 is 66, which is the equivalent time exposure, which is also a measure of the intensity. If the exposure had

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* Read before the Royal Society, Thursday, December 8th, 1887.

† "Roy. Soc. Proc.," vol. 36, p. 270.

### TIME SCALE FOR TABLE VI.

| No. of aperture. | Exposure given to portion of plate. | Light transmitted through developed plate. |
|---|---|---|
| | secs. | |
| 21 | 5 | 50·0 |
| 22 | 10 | 47·5 |
| 23 | 15 | 39·5 |
| 24 | 20 | 33·0 |
| 25 | 25 | 27·5 |
| 26 | 30 | 23·2 |
| 27 | 35 | 20·0 |
| 28 | 40 | 18·1 |
| 29 | 45 | 16·0 |
| 30 | 50 | 14·1 |
| 31 | 55 | 13·2 |
| 32 | 60 | 12·4 |

Bare glass = 56.

been prolonged to 1 minute it would be equivalent to an intensity of 264 (since the measured exposure was only 15 seconds). The other intensities were calculated in a similar manner. The intensities 21 and 264 were taken as points on the parabola, and the intermediate intensities calculated using the formula

$$W - m = n \sqrt{y}.$$

Table VII. is another example of the photographic measurement.

### TIME SCALE FOR TABLE VII.

| No. of exposure. | Time. | Readings of density. |
|---|---|---|
| 15 | 180 | 7·5 |
| 16 | 160 | 8·5 |
| 17 | 140 | 9·5 |
| 18 | 120 | 12·0 |
| 19 | 100 | 17·0 |
| 20 | 90 | 20·7 |
| 21 | 80 | 25·1 |
| 22 | 70 | 30·0 |
| 23 | 60 | 37·5 |
| 24 | 50 | 46·5 |

The above show that the parabolic form seems to be followed, but owing to the want of *absolute* uniformity in all parts of a photographic plate, and that errors may arise from want of exact exposure, and, again, from error in reading the densities, the values obtained are not so accordant as those taken by the visual method.

### TABLE VI.

| No. of exposure. | Lamp. | | | Exposure in seconds of small squares. | Light transmitted. | Equivalent time exposure. | Mean. | Reduction to one minute's exposure. | Calculated intensity. | By least squares. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Current. | Potential. | Power. | | | | | | | |
| 1. ... ... | 15·0 | 37·5 | 562 | 15 | 21·5 | 66 | 66 | 264 | 264 | 264·8 |
| 2. ... ... | ” | ” | ” | ” | 21·5 | 66 | | | | |
| 3. ... ... | 14·1 | 35·3 | 498 | 30 | 16·25 | 88 | 88·5 | 177 | 185 | 176·2 |
| 4. ... ... | ” | ” | ” | ” | 16·00 | 89 | | | | |
| 5. ... ... | 13·2 | 33·3 | 440 | 30 | 25 | 56 | 56·5 | 113 | 114·5 | 111·1 |
| 6. ... ... | ” | ” | ” | ” | 24·5 | 57 | | | | |
| 7. ... ... | 12·6 | 32·1 | 404 | 30 | 32·5 | 40 | 41 | 82 | 79·2 | 78·3 |
| 8. ... ... | ” | ” | ” | ” | 31·5 | 42 | | | | |
| 9. ... ... | 11·6 | 29·8 | 346 | 60 | 35 | 36 | 35 | 35 | 36·0 | 37·4 |
| 10. ... ... | ” | ” | ” | ” | 37 | 34 | | | | |
| 11. ... ... | 11·1 | 28·6 | 317 | 120 | 31·5 | 42 | 42 | 21 | 21 | 22·1 |
| 12. ... ... | ” | ” | ” | ” | 31·5 | 42 | | | | |
| 13. ... ... | 10·3 | 26·9 | 277 | 180 | 33 | 40 | 38·5 | 12·8 | 6·8 | 8·4 |
| 14. ... ... | ” | ” | ” | ” | 34·5 | 37 | | | | |
| 15. ... ... | 9·4 | 24·8 | 231 | 240 | 42·5 | 25 | 25 | 6·2 | 0·9 | |
| 16. ... ... | ” | ” | ” | ” | 42·5 | 25 | | | | |
| 17. ... ... | 9·2 | 24·4 | 224 | 360 | 39 | 31 | 31 | 5·2 | 0 | |
| 18. ... ... | ” | ” | ” | ” | 39 | 31 | | | | |
| 19. ... ... | 8·6 | 22·9 | 197 | 480 | 48 | 17 | 18 | 2·25 | 0 | |
| 20. ... ... | ” | ” | ” | ” | 47½ | 19 | | | | |

$m = 225.$ $n = 20·08.$

### TABLE VII.

| No. of exposure. | Lamp. | | | Exposure in seconds. | Light transmitted through negative. | Equivalent exposure. | Mean. | Reduced to one minute's exposure. | Calculated intensity. |
|---|---|---|---|---|---|---|---|---|---|
| | Current. | Potential. | Power. | | | | | | |
| 1. ... ... | 8·6 | 32·7 | 281 | 15 | 7 | 184 | (for 15 sec.) 186 | 744 | 736 |
| 2. ... ... | ” | ” | ” | 7 | 21·5 | 88 | | | |
| 3. ... ... | 8·0 | 30·2 | 242 | 30 | not readable | | (for 15 sec.) 134 | 536 | 529 |
| 4. ... ... | ” | ” | ” | 15 | 10 | 134 | | | |
| 5. ... ... | 7·7 | 29·0 | 223 | 40 | not readable | | (for 20 sec.) 144 | 432 | 432 |
| 6. ... ... | ” | ” | ” | 20 | 9 | 144 | | | |
| 7. ... ... | 6·6 | 24·9 | 186 | 60 | 8 | 168 | (for 60 sec.) 172 | 172 | 176 |
| 8. ... ... | ” | ” | ” | 40 | 12·5 | 118 | | | |
| 9. ... ... | 6·1 | 22·9 | 139 | 60 | 10·5 | 130 | (for 60 sec.) 130 | 130 | 130 |
| 10. ... ... | ” | ” | ” | 30 | 33·5 | 65 | | | |
| 11. ... ... | 5·4 | 20·0 | 102 | 120 | 9·75 | 138 | (for 120 sec.) 139 | 69·5 | 69·2 |
| 12. ... ... | ” | ” | ” | 60 | 31 | 70 | | | |
| 13. ... ... | 4·4 | 16·2 | 71 | 600 | 9·5 | 140 | (for 600 sec.) 141 | 14·1 | 15·2 |
| 14. ... ... | ” | ” | ” | 300 | 29·5 | 71 | | | |

## THE ELECTRIC LIGHT IN MILLS.

MR. WILLIAM SHANNON, local representative of the Gülcher Electric Light and Power Company, has just completed an installation of the electric light at the Rock Mills of Mr. G. K. Gilliland, J.P., Londonderry.

The installation consists of a Gülcher low-tension dynamo, upwards of 80 incandescent lamps of 20 candle-power, and one arc lamp of 2,000 candle-power, which is suspended by a block and fall arrangement from a very neat pole placed in the centre of the yard of the mill. The dynamo is capable of running 150 incandescent lamps of 20 candle-power, and delivering 14 horse-power in electrical energy at its terminals. It runs very steadily without sparking at a speed of 860 revolutions per minute, and is driven by a steam engine, which is also used for driving the plant of the mill. Every safeguard has been taken against any possible chance of fire, and the installation has been put up under the Phœnix Office fire rules. There is not only a safety fuse on the main switch, but one on every subsidiary switch and on every lamp. The lamps are suspended by silk flexible cords from ebony ceiling plates, which contain safety fuses, and are perfectly dust-proof, each pendant consisting also of a dust-proof ebony holder and a 6-inch opal shade. Lamps with flexible leads are to be used for placing inside the several machines to see that the silks and various parts are working satisfactorily. In each case where the cables pass from the old to the new mill they are run in earthenware pipes lined with asbestos. Whatever may be the sanitary or incidental advantages of electric lighting, there is one essential condition of its adoption, viz., it must benefit the pocket of the user. The advantage comes sometimes, not merely in the bare comparison with the gas bill, but in the longer hours and better work or reduced fire risk.

The lighting of corn mills differs somewhat from other mills, first, from the crowded position of the machinery, elevators, belts, and from the inflammable nature of the machinery and of the flour itself in all its stages. We know well the explosive character of an atmosphere laden with flour dust, and the condition in all the elevators and purifiers, and, indeed, all parts of a roller mill, is such as to make an ever present caution not merely desirable, but essential in this respect. The incandescent lamp may certainly be said to provide a security from dust explosion not attainable where gas is used. A sack of flour falling downstairs opens, perhaps; the contents are scattered, and where gas is used the dust catches fire, the windows are broken, and possibly part of the building lifted. A few minutes a day is sufficient for keeping everything in order, and mill-owners who have power to spare in their mills will find that they will benefit themselves in every way by the adoption of this, the light of the future. The whole arrangements were carried out by Mr. A. J. Baron, of the Gülcher Electric Light Company. Mr. Gilliland was the first miller in the north to introduce the roller mills, and now he is first again in an important improvement. We congratulate him on the success which has attended his labours. While on this subject we may state that Mr. Gilliland has entrusted Messrs. Victor Coates & Co., of Belfast, with an order to erect a new engine of 200 horse-power at the mill. The engine is to be on the newest principle, and designed specially with a view to giving steadiness to the electric lights.

## ELECTRIC LIGHTING IN DUBLIN.

AT a special meeting of the Municipal Council of the City of Dublin last week, Mr. ROBINSON moved a resolution authorising an application to the Board of Trade for a licence to the Corporation to supply electricity for public purposes within the city. Tenders had been received and referred to the City Engineer for examination and report, but he might say that the highest tender received coincided very closely with the amount set down in the submitted report. The City Engineer had safeguarded the city in every possible way in his specification. The whole responsibility of altering the buildings and supplying the plant was thrown on the parties tendering, who would be paid an annual rent of so much a year for so many lights. And if at any time the Corporation wished to purchase the plant they should be at liberty to do so, and those who tendered were asked to name a sum at which they would sell the turbines.

Mr. DOHERTY seconded the resolution, pointing out as a remarkable fact that the two or three members of the Council who were directors of the Gas Company were absent.

Mr. DENNEHY opposed the resolution, which he said could only result in very considerable expenditure. It would annihilate a very old manufacture in this city, and would wind up by imposing very serious liability on members of the Council. Mr. Mayne, Mr. Gray, and other able men had already paid considerable sums for purchasing their experience on this question. There had been many silly acts passed by the House of Commons, but there never was a more unworkable act than that of Mr. Chamberlain's, under which the Corporation now proposed to apply. No contract for lighting the city could be entered into except through the Gas Company. Mr. PETER M'DONALD thought it was very creditable to the gentlemen interested in the Gas Company that they had absented themselves. He thoroughly agreed with the resolution. It was putting in the thin end of the wedge into a great and injurious monopoly.

Mr. MAYNE said the reasons why money was lost in connection with the Electric Lighting Company in Dublin was that theirs was not only the first *bonâ fide* commercial electric lighting company started in the three kingdoms, but he believed the only one. They had to learn all their business and had to work with the only class of engine—the semi-portable one—which was at the disposal of the Electric Lighting Companies at that date. They had consequently to spend more upon coal for the working of their concerns by nearly ten times than they would have had if they had the improved engines. Even with all that disadvantage they had just turned the corner, and they had succeeded in making just as much profit in winter as compensated for any want of profit in the summer, and they had just arrived at a stage when the use of a little more capital spent on additional plant would have enabled them to earn so much profit that they could have given their shareholders a dividend. But just then the electric lighting panic set in, and their shareholders, forgetting that they were shareholders in a *bona fide* commercial concern, put themselves in the same boat with the shareholders of bogus companies, who were losing, and deserved to lose, the investments they had made. The shareholders got nervous, and in obedience to their fears the company was wound up. No sooner was the company out of existence than the Gas Company bought the plant cheaply, and charged considerably more than the Electric Lighting Company were charging, and making a profit out of it. He would be very much surprised if the Corporation, with the advantages they had, were not able to light the city very much better, and at a less cost than the Gas Company did.

The resolution was carried unanimously, and the meeting adjourned.

## OBITUARY.

### BALFOUR STEWART.

WE regret to announce the somewhat sudden death of Professor Balfour Stewart, M.A., LL.D., F.R.S. Mr. Balfour Stewart, who had only just completed his 59th year, was educated at the Universities of St. Andrews and Edinburgh. In 1859 he was appointed to the directorship of the Kew Observatory, and in 1867 to the secretaryship of the Meteorological Committee, which last appointment he resigned on his promotion to the Professor's chair of Natural Philosophy in Owen's College, Manchester, in the year 1870, a post which he held until his death. Two years before this distinction was conferred upon him he had been awarded the Rumford medal by the Royal Society for his discovery of the law of equality between the absorptive and radiative powers of bodies. Together with Messrs. De la Rue and Loewy he wrote "Researches on Solar Physics," and he and Professor Tait published their researches on "Heating produced by Rotation in Vacuo." Besides these he wrote a number of treatises especially on the subjects of meteorology and magnetism. The article in the "Encyclopædia Britannica" on "Terrestrial Magnetism" is from Professor Balfour Stewart's pen. Among the many works of which he was sole or joint author may be mentioned the "Elementary Treatise on Heat," "Lessons in Elementary Physics" (1871), "Physics" (1872), "The Conservation of Energy" (1874), and "Practical Physics" (1885). Most of these are text-books on the subjects of which they treat. He and Professor Tait also produced the "Unseen Universe," a work of which 12 editions have been published. At the time of his death he was President of the Physical Society, and was a member of the committee appointed to advise the Government on solar physics. Professor Balfour Stewart died on Monday last at Ballymagarvey, Balrath, in the county of Meath.

**The Western Union and Baltimore and Ohio Telegraph Companies.**—We learn that the absorption of the Baltimore and Ohio telegraph lines by the Western Union Company is in direct violation of a State law which is framed with the intent of preventing any company or association working or running telegraph lines within the borders of the State of Pennsylvania consolidating with any other telegraph company or association. The penalty for the infringement of this law is the confiscation by the State of the property in question.

## NOTES.

**The Treadmill and the Electric Light.**—In a leaderette dealing with the resolve of the Bradford Corporation to light the town with electricity, the *Daily News* of Thursday last week had the following interesting remarks: "We understand by the way that the Prisons Commissioners are prepared favourably to consider any scheme by which the enormous force expended on the cranks and treadmills throughout England may be utilised for generating electricity. There ought to be an opening for enterprise here. Any place would, of course, have to provide for the useful application of the electricity when generated, and it must be shown that it would pay. Mechanicians affirm that for the purposes of hard labour, there is nothing quite so satisfactory as the treadmill, and as electricity would permit of the labour being utilised to a great extent, irrespective of locality, the notion seems to be well worth consideration."

**Electric Lighting in Ireland.**—Last week the Derry Corporation in committee had under consideration several contracts for the lighting of the city by electricity. After some investigation and discussion, it was decided to instruct the solicitor to put before counsel the relations subsisting between the Corporation and the Gas Light Company, and have a legal opinion on the powers of the Corporation to enter into the proposed scheme. The question is causing a good stir locally.

**Electric Lighting v. Gas.**—In one large mill in Manchester where lighting by gas has been replaced by 930 electric lamps, the cost over a certain period has been £362 for maintaining the electric lamps, as compared with £510 which had previously been paid for gas at the rate of 3s. 2d. per 1,000 feet.

**Ship Lighting.**—Messrs. A. & J. Inglis, Pointhouse, launched on Saturday afternoon the *Oonah*, a steel screw steamer of 1,720 tons, which they have constructed to the order of the Tasmanian Steam Navigation Company, Hobart. The *Oonah* has been fitted with the electric light.

**Edinburgh and the Electric Light.**—There seems to be an inclination on the part of the Edinburgh Corporation to purchase the gas works from which the streets of the city are lighted, and Mr. Wm. John Menzies, who has recently been travelling in America, writes to the *Scotsman* strenuously advocating the adoption of the electric light in preference to the purchase of "an antiquated system of gas works."

**Electric Lighting Activity.**—Messrs. Woodhouse and Rawson, Limited, have recently carried out the installations for Messrs. Crosse and Blackwell, Messrs. J. and J. Murphy, Cork, and Lord Brassey, at his residence, Park Lane, the museum containing curiosities collected by the late Lady Brassey being lit up. A temporary installation for the Alpine Club at Willis's Rooms has also been amongst their recent work.

**New South Wales.**—We learn from the *Electrician and Electrical Engineer* that an American arc-light plant is to be erected at Sydney, New South Wales. One hundred tons of material for the purpose were recently shipped at New York.

**Electric Lighting in Philadelphia.**—The plans for the establishment of two electric lighting stations in Philadelphia have been approved. They will be respectively situated on the Delaware and Schuylkill rivers, the former station to be fitted with two condensing engines of from 300 to 500 H.P., and 16 dynamos with a capacity of 800 arc lights; the latter station to have three 500 H.P. engines, with 24 dynamos of 1,200 arc light capacity.

**Lighting of the Capitol at Washington.**—The Westinghouse Electric Company has obtained the contract for lighting the Capitol. The contract stipulates for lamps of various candle-power from 9, to 16, 26, 50, 75, 100 and 150 candles. The whole of the machinery will be placed in the building.

**Denver Light, Heat and Power Company.**—When the installation of this company's plant is completed, there will be in operation, supplied from the same station, 9,000 Westinghouse incandescence lamps, the Edison municipal plant of 800 20-candle lamps, and the commercial plant of 500 Brush arc-lights.

**Town Lighting.**—A wordy warfare is going on in the Tewkesbury *Weekly Record* respecting the proposal of the Corporation to buy out the gas company. One of the ratepayers of the borough, who signs himself "X.," advocates the adoption of electric lighting throughout the town, Tewkesbury being plentifully supplied with water-power during the greater portion of the year, and, he says, if this system of illumination will answer in such towns as Eastbourne and Leamington it will most certainly do so in the town which he represents. Another correspondent attempts to show that "X." is a visionary enthusiast and challenges him to point out a single instance of town electric lighting having been made a source of profit. As to the Leamington undertaking, says the latter gentleman, which has only been in existence five weeks, it has proved so unsatisfactory that the Corporation is about to have it discontinued for street lighting. Gas, we may add, in Tewkesbury averages about 4s. 5½d. per 1,000 cubic feet, so we imagine that an electrical contractor would stand a fair chance of making a financial success in this town with the water-power to help him. Perhaps Messrs. Chamberlain can give us some further explanation of the Leamington lighting.

**Electric Lighting in the City.**—At a meeting of the City Commission of Sewers on Tuesday, a report was brought up from the Streets Committee submitting for adoption a proposed arrangement with the Anglo-American Brush Electric Light Corporation for lighting a district of the city by means of electricity. Mr. Bell, the chairman of the committee, said the area proposed to be lighted was that between the Royal Exchange, Poultry, Ludgate Hill, and Fleet Street, on the north, and Queen Victoria Street and the Thames Embankment on the south. There would be 169 arc lamps instead of 616 gas lamps. The contract would be for seven years certain, with power to renew for a further period of seven years. On the suggestion of Mr. Pannell the consideration of the report was adjourned.

**Electric Lighting in Paper Mills.**—Mr. Greig, the manager of the Dartford Creek (*Daily Telegraph*) Paper Mills—on behalf of the proprietors—has placed an order for the electric lighting of the mills with Mr. Thomas Barton, a Lancashire electrical engineer. The installation, states the *British and Colonial Printer*, will be carried out upon Mr. Barton's improved system adapted for paper mills, the lighting of which he has made a speciality, having erected installations in 1884 at the Hollins Mill (Messrs. Potter & Co.), where there are two arc lights, and 300 incandescent lights, the type of dynamos used being two Victoria and one Gramme. In the same year the Darwen Paper Company, Darwen, put in 80 incandescent lights, and a Victoria dynamo. The paper mill at Poonah has 150 incandescent lights and a Victoria dynamo. Last year the Darwen Company was supplied with 300 incandescent lights and a Victoria dynamo for the Spring Vale paper mill; and Messrs. C. and J. G. Potter, of Darwen, took two arc lights and 150 incandescent lights, a Victoria and a Gramme machine. The Star Mill Company uses 350 incandescent lights and a Victoria dynamo.

**Street Electric Lighting in Berlin.**—The experimental lighting of Unter den Linden, which we reported as in progress some weeks ago, has now terminated. It was found that with three rows of arc lamps the illumination was fairly good, but not so brilliant as that established for the last five years in the Leipzigerstrasse.

**Telephones in Hospitals.**—The Equitable Telephone Association has received an order to fit up a number of its "A" form of "Swinton" telephones in the hospital for consumptives at Ventnor, Isle of Wight, for the purpose of affording communication between the different wards, the resident doctor, the porter's lodge, &c. The instruments will be connected on the exchange system, so that any one of them can be switched into communication with any other. It is expected that this installation will, when completed, save the hospital authorities much time and trouble.

**The Bell Telephone Company.**—This company has completed its arrangements for placing all its wires underground in Philadelphia. The ordinance requires that the work of constructing the conduits shall be carried on at night.

**The Atlantic Cables.**—The cable between Germany and Valentia, by which some of the Continental messages for America are sent *viâ* the Anglo-American lines, has been interrupted for several days. It is believed that the cable has parted somewhere off Hastings. A special staff has been sent from the Telegraph Construction and Maintenance Works to repair the fault if possible. No attempt, however, is being made at present to repair the Brest cable of the Anglo-American Company, which has not been worked for some months. This cable is an unfortunate one, as it was repaired last summer and after working a day or two broke down hopelessly again. It has not been worked since. Operations for restoring it will probably be attempted next spring. It is said that in the opinion of a competent telegraphic engineer a length of 800 miles let into the old Brest cable will make it as good as new. Meanwhile the Anglo-American messages are being transmitted over the three cables which still continue to work.

**Another Electric Meter.**—Herr Zacharias has introduced an apparatus for automatically recording the pressure kept in the mains of an electrical supply system which is in use in Berlin, according to the correspondent of *Industries* in the German metropolis, with very satisfactory results. The apparatus, which has been made by Messrs. Siemens and Halske, consists of an ordinary clock with a pendulum making 80 beats per minute, and which every 45 seconds closes an electric contact, throwing an electro-magnet into circuit. The armature of this magnet is balanced by a spring, so as to occupy a definite position when the standard pressure of 120 volts is in the mains. If the pressure is either greater or smaller, the armature occupies positions to either side of the normal. The armature is provided with a pin, in front of which a cylinder carrying a paper strip slowly revolves, a line marking the position which corresponds to 120 volts. At the moment of making contact with the electro-magnet the current is also sent through another electro-magnet, which presses the cylinder for an instant against the pin on the armature of the first magnet, and thus a hole is pricked, and the position of it on either side of the 120-volt line shows the variation of pressure existing at the moment. After a few seconds the current is again interrupted, and the same cycle of operations is repeated every 45 seconds; thus a series of marks is obtained on the paper strip, forming a record. Herr Zacharias also tried to obtain an absolutely constant record, by keeping the paper strip always up to the pin; but this not proving successful, the plan of recording at short intervals was adopted.

**An Electrical Tramcar for Australia.**—A new tramcar, fitted with electrical machinery by Messrs. Elwell-Parker, on the 15th inst. ran a trial trip on the Willenhall line of the Wolverhampton Tramways Company. The car has been constructed by the Midland Railway Waggon Company, Shrewsbury, for the Australasian Tramways Company. The electrical machinery is placed under the floor, at about the centre of the car, and when the vehicle is running only the necessary directing apparatus on each platform can be seen. The batteries are also utilised for the electric lighting of the car, which has two lights at each end, in the style of the ordinary tramcar.

**Worthy of Imitation.**—The Russian Minister of Ways of Communication has appointed a special commission to select the best system of electric lighting for railway carriages. This is the result of a decision recently arrived at to render the adoption of the electric light compulsory upon the principal railway companies for all passenger trains. The experiments will be conducted on the Nicolaieff Railway, and are not expected to last more than a month. The South Russian Railway Company, it should be noted, has already adopted the electric light for all fast trains running between Odessa and Kieff, while it has been used in the special Imperial trains for some time past.

**Discussion on Electrical Tramways.**—We listened with pleasure to the admirable reply of Dr. E. Hopkinson to the attacks of his would-be critics at the Institute of Civil Engineers on Tuesday last. There were not wanting among the speakers those whose object was rather to advertise their wares than to add to the scientific value of the discussion and to those cursed with a "system" Dr. Hopkinson administered some very good advice. A reply more characterised by fairness to everyone concerned we have never heard, and, as the speaker said, the great mistake hitherto made by writers on electric locomotion has been in neglecting to consider the adaptability of their apparatus to the peculiarities of the case with which they have had to deal. There is no system the best under all circumstances; for one case one arrangement is preferable for another another arrangement. We have a high opinion of Dr. E. Hopkinson, and he displays the discrimination which the engineer ought always to possess when he refuses to have anything to do with a "system."

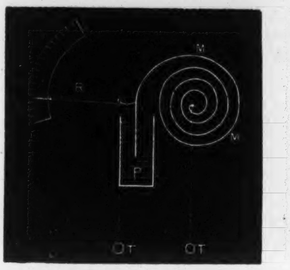
**Compound Winding.**—Mr. Varley's article on this subject will be completed in our next issue, which forms the last number of Vol. XXI., and we think that every unbiased reader will come to the conclusion that he has pleaded his cause most effectively and made out a very good case. His position in this matter forcibly reminds one of that occupied by Paul la Cour in connection with the multiplex telegraph, with which invention Mr. Delany is credited. Both cases are examples of the powerlessness of right against might.

**Metal Extracting.**—The letters which we publish this week on the subject of extracting metals electrically will doubtless bring forth a reply from Mr. Fenwick. We are anxious to learn in what manner this gentleman will combat the points advanced by our correspondents.

**The "Great Eastern."**—This vessel, now lying in the Clyde, has been purchased by a firm of metal brokers, and it is understood that she is to be broken up, an operation estimated to cost £10,000 to £15,000. We have now probably heard the last of this famous but ill-fated ship.

**"The Queen's Head."**—This is the title of a magazine of articles, tales, and poems relating to postal telegraph life and work. It is written by Glasgow P.O. officials, with an introduction by Mr. Hobson, the present postmaster of that city. It is published by Messrs. Aird and Coghill, Glasgow.

**Electrical Measuring Instruments.**—Mr. G. A. Moore, of Liverpool, writes to us as follows:—"I have not seen any suggestion as to the application of the Cardew principle to the construction of ammeters, though I have no doubt it has occurred to many. I enclose a sketch showing how I think it might be effected."



M, iron wire spiral dipping into mercury, P; R, finger showing degree of expansion caused by the current heating spiral; T, T, terminals. Perhaps Captain Cardew would like to express an opinion upon Mr. Moore's suggested arrangement.

**Fires and Wires.**—A large fire occurred in Shoreditch on Wednesday evening, and it is stated that the telegraph wires running over the burning buildings gave way and fell with a loud crash; nobody, however, was injured.

**A New Small-Power Motor.**—There was on view at the Saltaire Exhibition a steam engine and boiler combined (Wormald and Hargreaves' patent), made by the Leeds Engineering and Hydraulic Company. Its construction is remarkably simple, and it occupies less space than any other steam engine and boiler of the same power. There are no working parts to get out of order, all stuffing boxes and glands being done away with, and the principal bearings being made self-adjusting. The fuel may be coal, coke or wood and the whole arrangement can be mounted on wheels if required to be portable. Recently a larger engine of this kind has been used in the printing of a newspaper at Brighouse, and the proprietor gives the following particulars of it:—"The engine is compound, with 6 and 8½-inch diameter cylinders, 5-inch stroke, with trunk pistons. The cylinders are suspended in the steam space of the boiler, thus pefectly steam jacketing them and preventing all loss from condensation. The two slide valves are worked from one eccentric, and there are no stuffing boxes except for the valve spindle. On the top of the boiler is a neat cast iron box, in which is fitted the bearings for the crank shaft, and it also covers in the whole of the working parts. The boiler has a mild steel fire box fitted with two Galloway tubes. It is mounted on a cast iron cistern, from which the feed water is taken by a pump fixed on the side. The water is heated in the cistern by the waste heat from the boiler fire. All the working parts are easily accessible, and all the lubrication is done from outside the box or covering. The engine is the first of its kind turned into the market, is an improvement on one which has had nearly a twelve month's test at the company's works, and is likely to supply a growing demand for good, economical, and at the same time "reliable" motors. Tested with coke as fuel, the cost of running has been one farthing per horse-power per hour on the brake, giving off 5 H.P. The engine and boiler occupies a floor space of 4 feet by 3 feet 6 inches. Being covered with silicate of cotton, neatly lagged and polished, there is little or no radiation from the boiler, and the whole presents a neat and very compact appearance. The only essential parts visible are a couple of 3 feet fly wheels, each weighing about 2½ cwt., the governors, and steam and water gauges."

**Electric Lighting in South Australia.**—The Town Council of Tamworth, New South Wales, having resolved to light the town by electricity, the tender of Messrs. Harrison & Whiffen, of Sydney and Adelaide was accepted. The sum of £3,000 was voted for carrying out the scheme. It is not proposed to increase the lighting rate.

We have received particulars of the lighting of Mr. L. Conrad's butcher's shop, Hindley Street, Adelaide, by electricity by the same firm. Eight incandescent lights are suspended in the centre of the shop and two in each of the four windows, the outside being supplied with two groups of four each, making altogether 24 lights. Inside the shop are switches by means of which the lights can be easily turned on or off. The machinery is at the rear. One of Messrs. R. E. Crompton & Co.'s 30-light dynamos is driven by a belt from the countershaft of the machinery at a speed of 1,600 revolutions per minute. These incandescent lamps take the place of 81 gas jets. One of the great advantages in having the shop lit by the electric light is that it is always kept at the same temperature. The meat, therefore, will be kept comparatively cool. This is the first shop in Adelaide which has been lit entirely by electricity, although Mr. W. Kither's butcher's shop in Rundle Street has been partly lit by that means for some time.

**The Industrial Crisis in France and the Labour Question.**—A curious phase of commercial history is revealed in a report on the budget of the communes drawn up by Mons. Felix Faure, deputy for the Seine Inférieure. It is a mistake (he thinks) to attribute the commercial depression which for some time has so gravely affected French industries, to over production. This certainly may have been the case up to 1882, but during the last five years production has seriously diminished. It is more probable that we are passing through a readjustment of wealth. The value of the human equation is being sensibly raised, and the value of capital is decreasing. On all sides the price of labour is advancing and revenue is falling. While there is actually a greater demand for labour, it is becoming more difficult to obtain, and this is to be attributed to several causes; the physical efforts of man are less, emigration to new countries steadily increases, and the exigencies of military service divert from the field of labour a very large proportion, for, without counting the calls upon the reserves, the standing armies (on a peace footing) of the five great European powers number no less than 2,500,000 men. Again, the abundance of capital has brought about such keen competition that in industries and commerce, an interest of 3 or 4 per cent is now obtained, where a few years back 5 or 6 per cent was returned. State revenues which some 10 years ago could be fixed at between 4 and 5 per cent. have diminished at least a fourth.

**The Society of Telegraph-Engineers and Electricians.**—The annual *conversazione* of this society was held on Thursday, December 15th, in the Galleries of the Institute of Painters in Oil Colours, Princes Hall, Piccadilly. The visitors were received by Sir Charles Bright, the President of the Society, and Lady Bright. Owing to the largeness of the attendance, which considerably exceeded the number expected, a complete breakdown of the cloak room arrangements ensued, resulting in great inconvenience to the visitors, many of whom had to leave at a late hour in borrowed plumes, and some without hats and overcoats at all.

**American Electric Tramways.**—In addition to 22 electric tramways already in operation in America, there are 16 in course of construction or under contract, and 54 projected.

**Electric Fire Alarms.**—In Chicago alone three instances have occurred within the month, showing the utility of electrical appliances for giving warning in cases of fire. In two cases buildings were saved from destruction, and in the third, the guests in the Saratoga Hotel, which was recently burned, were aroused in time to effect their escape by the bells in their rooms being rung by the fire alarm in the hotel office.

**Practical School of Engineering.**—On Saturday afternoon last, at the Crystal Palace, a meeting of the friends and students of the Crystal Palace Company's Practical School of Engineering was held for the purpose of awarding certificates to the successful students at their recent examination. Mr. W. H. Preece, F.R.S., occupied the chair, and there was a large attendance. The report of the examiners in the mechanical section stated that 30 students had attended the lectures, 25 were eligible for examination, and 11 had passed satisfactorily. The lecture work had been good, but the examination paper work was not quite up to the average of previous terms. In the civil engineering section the examiner stated that the results of the *vivâ voce* examination had been very satisfactory. Mr. W. H. Preece, before awarding the certificates, gave an address to the students on the position of the engineering profession at the present day, in the course of which he stated that the duties of a civil engineer were very various and very wonderful. A civil engineer must know something of geology, of mineralogy, and geography ; he must thoroughly understand the earth, the sea, and the atmosphere ; he must know something of heat and light, of sound and its laws ; and he must thoroughly understand electricity, chemistry, dynamics, and kinetics. In order for anybody to qualify to practice in such a profession it was necessary that he should pass through a very varied and severe course of training. The certificates having been awarded to the successful students, Mr. J. W. Wilson, principal of the school, stated that since its commencement 690 students had been through the school, and no less than 135 of the leading engineers of the day had acted in the capacity of examiners and chairmen, and 172 of their students were now students of the Institution of Civil Engineers.

**Chile Copper Bars.**—The following figures, taken from Ryland's Iron Trade Circular, show the highest and lowest prices per ton during the last 10 years :—

| Year. | Highest. | | | Lowest. | | |
|---|---|---|---|---|---|---|
| | £ | s. | d. | £ | s. | d. |
| 1876 | 81 | 15 | 0 | 70 | 0 | 0 |
| 1877 | 76 | 0 | 0 | 63 | 0 | 0 |
| 1878 | 66 | 10 | 0 | 55 | 0 | 0 |
| 1879 | 67 | 10 | 0 | 53 | 0 | 0 |
| 1880 | 74 | 0 | 0 | 54 | 10 | 0 |
| 1881 | 72 | 10 | 0 | 57 | 0 | 0 |
| 1882 | 71 | 10 | 0 | 63 | 0 | 0 |
| 1883 | 67 | 10 | 0 | 57 | 0 | 0 |
| 1884 | 57 | 0 | 0 | 50 | 0 | 0 |
| 1885 | 49 | 7 | 6 | 39 | 2 | 6 |
| 1886 | 43 | 7 | 6 | 38 | 10 | 0 |

**Lighthouse Illumination.**—At a recent meeting of the Junior Engineering Society a paper was read on "Illumination of Lighthouses," by Mr. F. R. Taylor, who, in introducing the subject, briefly traced the development of the maritime signal from the primitive beacon to the elaborate lighthouses of the present time, and stated how great was the importance of efficient coast and other lights. The relative efficiencies of oil, gas, and electricity, as illuminants were discussed, their respective advantages under varying circumstances being indicated.

**Electrical Engineering in the United States.**—At a meeting of the Mason College Engineering Society, held at the Mason Science College, Birmingham, on Wednesday, December 7th, Mr. Edward L. Joseph read a paper on the above interesting subject. The author treated the matter in a very able manner, touching on the various branches of the applications of the science, and concluded by showing that the reason of the much more general use of electric light in the States was not due so much to the cost of gas or any Electric Lighting Acts, but to the generous spirit of enterprise which our cousins possess in making use of the *best* light. This also applies to all the other branches of electrical engineering. Mr. Joseph, having spent nearly two years in various States of the Union, was able to a great extent to speak from practical experience.

**Popular Science Lectures.**—Mr. W. Lant Carpenter delivered the second of a course of three lectures on "Electricity in the service of man," in the grand hall of the International College, Finchley New Road, on the afternoon of the 15th inst. to a large audience, Mr. James Haysman, F.R.C.S., Principal of the college, presiding. The lecture, which was illustrated by experiments, was devoted to a discussion of electric lighting and transmission of power. The lecture was listened to with the greatest attention throughout.

**Royal Society.**—Amongst the papers announced to be read at yesterday afternoon's meeting was one by Mr. W. H. Preece, F.R.S., on "The heating effects of electric currents, No. II.," this paper having been postponed from the previous meeting.

**Electric Apparatus Company.**—This company has just issued a third edition of its catalogue of electric lighting apparatus and material, with illustrations of various forms of machines, steam and gas engines, lamps and other requisites. At the end approximate estimates are given for complete sets of plant. The information given throughout the book would be found valuable by any one contemplating the adoption of this method of illumination.

**"Electrical Plant."**—The monthly publication bearing this name, issued by Messrs. Wheatley Kirk, Price and Goulty, which has hitherto appeared on the 15th of each month is to be published in future on the 1st. We understand that a large measure of success has attended this effort to bring buyers and manufacturers together.

**Timing Races by Electricity.**—A Hartford, Conn., man has invented an apparatus for timing horses. A clock with three hands—minute, second, and quarter second—is started by the official timer. When the winning horse touches the wire the clock is stopped by electricity. At the same instant the current opens a camera, which photographs the horse and the clock face.

## NEW COMPANIES REGISTERED.

**Blockley Electric Lighting and Manufacturing Company, Limited.**—Capital : £20,000 in £5 shares. Objects :—To acquire a mill at Blockley, Worcester, with water and other power, and to carry on in all branches the business of an electric light company. Signatories (with 1 share each) :—*Lord E. Spencer Churchill, Hy. Montague Spencer, Moreton-in-Marsh ; *A. W. Hall, M.P., Oxford ; *Rev. Hy. Barter, Charles Barter (electrical engineer), Shipton-under-Wychwood, Oxford ; Rev. Canon Warburton, H. N. Warburton (electrical engineer), Winchester. Directors' qualification : £25 in shares. Remuneration : £100 per annum. The signatories denoted by an asterisk are the first directors. Registered 16th inst. by Warren, Gardner, and Murton, 45, Bloomsbury Square. Registered office, Blockley, Worcester.

**Jensen Electric Bell and Signal Company, Limited.**—Capital : £100,000 in £1 shares. Objects : To acquire the business in connection with Jensen's patent electric bell and signal system, and all patent rights for Great Britain and foreign countries other than the United States and Canada. Signatories (with 1 share each) : A. R. Cole, Whitton ; A. C. Dockerill, 160, Albion Road, N. ; C. Isaac, 105, Warwick Road, W. ; J. Spencer, 9, Fenchurch Street ; R. H. Gould, 11, Great Coram Street ; F. Burr, 43, Porson Street, Lewisham ; E. B. Howard, 9, Lebanon Street, Walworth. The signatories are to appoint the first directors. Qualification : £100 in capital. Remuneration : £750 per annum when 10 per cent. dividend is paid, with a further £100 for each additional 1 per cent. Registered 17th inst. by Chinery, Aldridge & Co., 2, Brabant Court, Gracechurch Street.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Nightingale Automatic Electrical Machine Company, Limited.**—An agreement of 30th ult. provides for the purchase from Matthew Cranswick Greenhill, of 8, Romola Road, Herne Hill, engineer, of the letters patent, No. 14,062, of 1887, granted to him under the name of Edgar Pullar, for improvements in automatic medical electric apparatus. The purchase consideration is £400, and the fully paid "A" share of £1. This share will entitle the holder thereof, after the £400 has been recouped to the "B" shareholders, to 25 per cent. of the residue of the profits, until the same shall amount to £1,600. Of the remaining profits, five-twelfths will belong to the "A" shareholder, and the remainder to the "B" shareholders. Registered office, 3, Queen Street, Cheapside.

**Taylor and Tucker, Limited.**—An agreement of 29th ult. regulates the purchase by the company of the business of this firm. The consideration is £2,475 18s., payable £974 18s. in cash, and the remainder in fully paid shares. Mr. Joseph Taylor is appointed manager for seven years at a salary of £200 for the first year, and a further sum of £50 in the event of there being sufficient to pay the same out of the profits after 10 per cent. dividend has been paid, and due provision has been made for bad debts, goodwill; and a further sum of 10 per cent. of all surplus profits after such payments have been made. For subsequent years the salary of Mr. Taylor will be £250 per annum, and the percentage as aforesaid. Mr. Tucker is to be appointed a managing director for seven years at a salary of £250 for the first year, and a further sum of £50 after payment of 10 per cent. dividend, and making provision for bad debts, &c., and a further sum of 15 per cent. of all surplus profits after such payments. In succeeding years Mr. Tucker's salary will be £300 per annum, and 15 per cent. of any surplus profits as aforesaid.

**Platinum Plating Company, Limited.**—This company will adopt an agreement for the purchase from the Bright Platinum Plating Company, Limited, of certain letters patent granted to Wm. Arthur Thoms for the deposition of platinum by electricity. The consideration is £20,000 in cash, and 900 fully paid founder's shares of £1 each. Registered office, 27, Clement's Lane.

**Phonopore Syndicate, Limited.**—The British letters patent to be acquired by this company are as follows:—No. 10,990, August 6th, 1884, for improvements in telephony; No. 4,506, April 11th, 1885, for improvements in telegraphs; No. 7,799, June 26th, 1885, for improvements in telegraphy and telephony; No. 16,616 December 16th, 1886, grant of provisional protection relating to apparatus for the employment of vibratory electricity in telegraphy. The purchase also includes patents for the United States, France, Germany, Belgium, Austria, Italy, Spain, Portugal, Norway, East Indies, Russia, Sweden, Denmark, and Canada, and also registered trade marks for the United Kingdom and Holland. The purchase consideration is 6,000 fully paid deferred shares, and £30,000 in cash or fully paid ordinary shares at the option of the vendor.

**Sunbeam Lamp Company, Limited.**—An agreement of 22nd ult. provides for the purchase from Messrs. Wm. Clarke, A. H. Chapman, the Hon. C. A. Parsons, and J. B. Furneaux, of Gateshead, of certain processes for the manufacture of incandescent lamps, for 2,000 fully paid shares of £10 each.

**Latimer Clark, Muirhead and Company, Limited.**—The annual return of this company made up to the 13th inst. was filed on the 15th inst. The nominal capital is £100,000 in £10 shares. The number of shares taken up is 4,709, upon which the full amount is considered to be paid.

**Blackpool Electric Tramway Company, Limited.**—The annual return of this company made up to the 10th inst. was filed on the 16th inst. The nominal capital is £30,000 in £10 shares, the whole of which have been taken up. Upon 2,850 shares the sum of £6 10s. per share has been called up, and upon 150 shares the full amount has been called. The calls paid amount to £20,021 leaving £4 unpaid.

**Schanschieff Electric Battery Syndicate, Limited.**—The statutory return of this company made up to the 12th inst. was filed on the 17th. The nominal capital is £25,000 in 100 shares of £250 each. 40 shares have been taken up and the full amount has been called thereon.

**Railway Train Telegraphy Company, Limited.**—The registered office of this company is at 11, Queen Victoria Street.

## CITY NOTES, REPORTS, MEETINGS, &c.

### Gulcher Electric Light and Power Company, Limited.

MEETINGS of the debenture holders, shareholders and creditors of this company were held at the Cannon Street Hotel on Monday last, under the presidency of Mr. Daniel de Castro, the liquidator, to consider the proposed scheme of arrangement referred to in the REVIEW last week.

The Chairman stated that the company had been carried on by him as liquidator for the last six months, and as far as he could see they had paid their way and perhaps a little more. He could not state their exact position until they had taken stock. With reference to the scheme, the great question would no doubt be what amount of support they could obtain from the debenture holders. The amount of the debentures was £8,000, of which £5,000 represented the interest of *bona fide* investors, and the other £3,000 represented the debentures issued to guarantee the directors that amount, which they advanced for temporary purposes. He believed that the debenture holders would find £4,000 towards the £20,000 required, and that the creditors would find between £4,000 and £5,000. There were shareholders and outsiders who would make up £10,000, the amount he had had practically promised to him if the thing succeeded. Another £10,000 would have to be found somehow, which could be obtained by an appeal to the public or the shareholders, unless the debenture holders elected to increase their stake. The company was going on fairly well, even in its present state of liquidation, and the prospects of business if it were carried on were very fair indeed. The orders he had in hand at the present moment as liquidator amounted to nearly £1,700, and if they went on he felt quite confident of being able to obtain orders to the amount of nearer £8,000 than any other round figure. The amounts due from customers had increased since July from £3,365 to £3,667.

Mr. A. Trinder, the solicitor, stated that in the scheme sent out and submitted to the chief clerk reference was made to the directors of the new company being four in number; but at an informal meeting of shareholders, debenture holders, and creditors a wish had been expressed that the first directors should number seven—two to represent the debenture holders, two the shareholders, two the ordinary shareholders, and one outsider to be selected by the other six. The resolution to be submitted would be for approving the scheme, subject to the number of the directors being seven, representing the interests of the debenture holders, shareholders, and ordinary creditors, as indicated.

The Chairman stated, in answer to Mr. Ogle, that, assuming the debentures to be good, the property at a forced sale was worth from £10,000 to £12,000. In reply to Mr. Cotton, he stated that a question had been raised as to whether the debentures had been validly issued. The objection was of the most trivial character.

Mr. Trinder, in further reply, stated that if the scheme went through, and £20,000 were obtained, the legal point referred to would not be raised.

Mr. Cotton then moved and Mr. C. Foulsham seconded a resolution approving the scheme, which was passed.

Mr. Henry Grewing and Mr. Thomas Lloyd were appointed two of the directors of the new company to represent the debenture holders.

Mr. Trinder, addressing the shareholders' meeting, stated the circumstances in which the new company which had been at first contemplated had fallen through.

The Chairman, in answer to questions, stated that the nominal capital of the company now proposed was £50,000, but it was only intended to issue £20,000 of preference shares. They would be entitled to a dividend of 10 per cent., any surplus profits beyond that being divisible equally between the preference and the ordinary shareholders. They feared they could not obtain the money on more favourable terms. The more he was associated with the company the more convinced he was that it was really sound; and the creditors had also arrived at the same conclusion.

The resolution approving the scheme was then carried, with three dissentients; and Mr. de Castro and Mr. William Wallace were elected directors of the new company to represent the shareholders.

At the meeting of creditors resolutions were passed approving the scheme, and electing Mr. Gustav Binswanger and Mr. Howard Lane to represent them on the board of the new company. It was suggested that if the proposed scheme of reconstruction could not be carried through by February 28th next the creditors should be again called together or the scheme be dropped.

**National Company for the Distribution of Electricity by Secondary Generators, Limited.**—The accounts of this company for the year 1886 show that after writing off £751 for depreciation of plant, preliminary and other expenses, there remains a balance to be carried forward of £222, the amount brought into the accounts having been £1,862.

**Eastern and South African Telegraph Company, Limited.**—The coupons due on January 2nd on the 5 per cent. mortgage debentures of this company will be paid by Messrs. Barclay, Bevan & Co., 54, Lombard Street, E.C. Coupons should be left three clear days for examination.

**Eastern Extension, Australasia, and China Telegraph Company, Limited.**—This company notifies the declaration of an interim dividend for the quarter ended September 30th last of 2s. 6d. per share, free of income-tax, payable on January 14th next.

**The West Coast of America Telegraph Company, Limited.**—The coupons due to the 31st inst. on the debentures of this company will be paid by Messrs. Barclay, Bevan & Co. The coupons must be left three clear days for examination.

## TRAFFIC RECEIPTS.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th December are £2,751, as compared with £2,222 in the corresponding period of 1886. The August receipts, estimated at £4,008, realised £4,107.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending December 16th were £4,082, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended December 16th amounted to £5,052.

## NEW PATENTS—1887.

16824. "Effecting electric illumination of theatres, &c., by fire-proof means." S. SUDWORTH, E. L. BERRY. Dated December 7.

16849. "Galvanic batteries." G. A. SCHOTT. Dated December 7.

16859. "Electrical accumulators." C. D. ABEL. (Communicated by C. Zipernowsky.) Dated December 7.

16863. "Automatic electrical distribution and charge of secondary batteries." F. KING. Dated December 7.

16870. "Electro-dynamic generators." R. TATHAM. Dated December 8.

16880. "Telephonic call boxes." A. E. COTTERELL. Dated Dated December 8.

16915. "Electrical transformers and plates therefor." J. G. STATTER. Dated December 8.

16926. "Electro-deposition of metals." T. FENWICK. Dated December 8.

16977. "Clutch action for gripping the feed rods in arc lamps in combination either with a solenoid or an electro-magnet working as a shunt in the main current to control the length of the arc." J. KENT. Dated December 9.

17031. "Regulating electric currents; apparatus therefor." W. LAHMEYER. Dated December 10.

17038. "Mechanical telephone lines." W. H. MUNNS. (Communicated by I. M. Monjo." Dated December 10.

17047. "Secondary batteries." F. KING. Dated December 10.

17055. "Electro-magnetic combination locks for safes and vaults." S. P. WILDING. (Communicated by C. J. Kintner and — Herzog.) Dated December 10.

17058. "Electro-magnetic combination locks for safes and vaults." S. P. WILDING. (Communicated by C. J. Kintner and — Herzog. Dated December 10.

17089. "Armature cores of dynamo machines." M. IMMISCH. Dated December 12.

17138. "Voltaic induction apparatus which may be applied to and combined with dynamic generators." R. H. COURTENAY. Dated December 13.

17155. "Cut-out devices for incandescent electric lamps." T. A. EDISON. Dated December 13.

17157. "Galvanic batteries." H. H. LAKE. (Communicated by J. O. Whitten.) Dated December 13. (*Complete.*)

17175. "Phonographs and phonograms." G. E. GOURAUD. (Communicated by T. A. Edison.) Dated December 14.

17183. "Clips, connectors, or couplings for electrical wires, &c." G. WILKINSON, D. A. BREMNER. Dated December 14.

17186. "Ornamenting metallic, &c., surfaces by electro-deposition of metals." R. E. HIDES. Dated December 14.

17209. "Combined switch and electric lamp support for conveyances." J. WILLING, A. D. DOUGLASS. Dated December 14.

17231. "Distributing electricity." H. EDMUNDS. Dated December 14.

17232. "Electric circuits; for protecting them and preventing danger due to leakage and short-circuiting." W. T. GLOVER, H. EDMUNDS. Dated December 14.

17235. "Armatures for dynamo-electric machines." E. J. PATERSON, C. F. COOPER. Dated December 14.

17267. "Electric switch." A. W. SOUTHEY, H. MELLOR. Dated December 15.

17298. "Electro-pneumatic action." E. H. SUGGATE. Dated December 16.

17304. "Carriers for pneumatic tubes." F. B. WELCH. Dated December 16.

17320. "Apparatus for lighting incandescent electric lamps." C. AUTY. Dated December 16.

17394. "Mechanical telephone lines." W. H. MUNNS. (Communicated by I. M. Monjo.) Dated December 17.

17409. "Electrical primers or fuses." C. A. MCEVOY. Dated December 17.

17415. "Measuring and recording apparatus." J. G. LORRAIN. Dated December 17.

17457. "Electric safety lamps." H. E. M. D. C. UPTON. Dated December 19.

17502. "Electricity meters; dynamo-electric generators and motors." G. HOOKHAM. Dated December 20.

17508. "Electrical switches." F. L. RAWSON, W. WHITE. Dated December 20.

17528. "Phonic reception of telegraphed communications." C. ADER. Dated December 20.

## ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1886.

14026. "Improvements in electric arc lamps." C. A. PARSONS. Dated November 1. 11d. The regulation of the arc is effected by the use of a solenoid in series with the lamp in connection with an iron core, which through cords wound on a snail and wheel, respectively, balances or partially balances the weight of the upper carbon and holder; or where it is required to use the lamps in series or multiple series, parts of the coils on the series solenoid can (as is well understood in connection with known arc lamps) be replaced by a fine shunt wire in a manner that will be readily understood. The claims are 7 in number.

14045. "Improvements in electric bells and indicators." W. P. GRANVILLE. Dated November 1. 8d. Claims:—1. A combined electric bell and indicator, in which the electro-magnet used for ringing the bell has working with it a swinging bar magnet, which can be swung by the electro-magnet into one or other of two positions according to the direction of the current passed through the electro-magnet coils, and so made to exhibit one or other of two signals whenever the bell is rung. 2. The construction of a combined electric bell and indicator, substantially as described and illustrated in the drawings.

14568. "Improvements in electric safety lamps." A. HOWAT. Dated November 11. 8d. The inventor mounts the incandescent lamp on a stand or holder and connects the platinum wire terminals to the wires of an electric battery, the circuit being completed or broken at will by means of a switch or lever. He surrounds the lamp globe with a strong glass dome or globe and secures it firmly to the stand or holder, taking care to make an air-tight joint between the dome and the stand in such manner that a chamber or air space is formed around the lamp globe. The stand or holder is provided with a pipe or passage which communicates with the chamber and is controlled by a valve, and there is also a hole or opening in the stand which is covered by a diaphragm of India-rubber, or other suitable air-tight and yielding material, so arranged that when pressed outward it will operate the switch lever and complete the circuit. When the lamp is to be used he connects the passage leading into the chamber to a pump and forces air into the space between the globe and the dome until the air is sufficiently compressed to force the flexible diaphragm outward, thereby operating the switch lever, completing the electric circuit, and lighting the lamp. The claims are 3 in number.

14942. "Improvements in volt-meters. J. S. RAWORTH. Dated November 17. 8d. Claim:—A volt meter constructed with resistance coils whereby the indications of the instrument can be proportionally varied, and with a dial or dials whereby the indications can be read or interpreted, such dial or dials showing the proportionate or relative variation between the reading of the instrument and the force acting upon it, substantially as described with reference to the drawings.

16440. "Improvements in electric arc lamps." W. J. MACKENZIE. Dated December 15. 8d Claims:—1. The combination of parts constituting the improved electric arc lamp described. 2. In an electric arc lamp the employment of pneumatic pressure or a vacuum in conjunction with electrical devices for striking and regulating the arc, substantially as described. 3. In an electric arc lamp the combination of a float supporting the movable carbon, a regulating float communicating therewith and a solenoid or its equivalent arranged to operate the regulating float, substantially as set forth. 4. In an electric arc lamp a regulating float having in it an orifice for the escape of air, substantially as and for the purpose set forth. 5. In an electric arc lamp a carbon holder consisting of a tube carried in a ball and socket joint movable and adjustable on the lamp frame, substantially as and for the purposes set forth.

16662. "Improvements in means for automatically regulating electric generators." R. P. SELLON, W. M. MORDEY and C. E. WEBBER. Dated December 18. 8d. Claims:—1. In a separately excited alternate current dynamo-electric machine the means for the automatic control of the field magnetism of the separate exciter, substantially as described with reference to the diagrams. 2. In a separately excited alternate current dynamo-electric machine the automatic control of the field excitation by directly varying the resistance or the number of coils in the exciting circuit substantially as described. 3. In a separately excited alternate current dynamo-electric machine the automatic control of the field magnetism of the separate exciter by means of a relay device, substantially as described with reference to the diagrams. 4. In a separately excited alternate current dynamo-electric machine the automatic control of the field magnetism by a relay device, substantially as described. 5. In a separately excited alternate current dynamo-electric machine regulation by partial excitation of the field by a commutated current from the alternate current armature and partly by current supplied from a separate exciter the automatic control being exerted on either (or both) of these as described with reference to the diagrams. 6. In a separately excited alternate current dynamo-electric machine regulation by automatically varying the strength of the field, substantially as described.

## CORRESPONDENCE.

### The Extended Electro-Metal Extracting, Refining, and Plating Company.

Now that this company has issued a prospectus, it is only fair to the public that the same should be analysed, so as to give intending speculators an idea of the concern in which they are thinking of embarking their capital.

The first notice in the prospectus is that of extracting tin from scrap or waste tin cuttings.

You have had occasion to write upon this subject before, when you gave your opinion to be that the iron recovered from these products was totally unfit for the ordinary usages to which iron is put. This opinion need in no way be altered, in fact, from enquiries made from large firms who have experimented with quantities of iron got from electrolytic cleaning of tin scrap the same story is received, viz., its being totally unfit. The reason they give is, that however clean the iron may be from tin, there still remains a trace, which in alloying with the iron on melting completely ruins the same ; next take the quality of the tin recovered, this undoubtedly is fairly pure, but has to be remelted and partly refined, which entails cost and also a loss of tin. Next we come to the working costs of scrap, &c.

| DR. | £ | s. | d. | CR. | £ | s. | d. |
|---|---|---|---|---|---|---|---|
| 33 tons scrap, at 5s. per ton .. | 8 | 5 | 0 | One ton of pure tin, &c. at .. | 100 | 0 | 0 |
| Cost of extracting one ton of tin from 33 tons of scrap, at 20s. per ton .. .. .. .. | 33 | 0 | 0 | Remaining 32 tons of best. &c., iron stripped of tin at 21s. per ton .. .. .. .. | 33 | 12 | 0 |
| Profit balance on treatment of above .. .. .. .. | 92 | 7 | 0 | | | | |
| | £133 | 12 | 0 | | £133 | 12 | 0 |

We will pass the 5s. per ton of scrap, a figure, however, we do not altogether agree with, as carriage alone would monopolise a large part of the same without cost of collecting, packing, &c., but must take exception to the low cost of £1 per ton of scrap for labour, working dynamos, and chemicals. The cost of power to perform this, taking a very low figure, would be at least £3 ; next, the scrap being very unhandy to move about, the tin recovered being in a peculiar state, would take a considerable amount of labour ; this would be at least £25, melting and refining tin £5, carriage of iron to destination 3s. per ton = £4 12s, and lastly, the chemicals used ; in this the very nature of the work would render the solution used very impure in a short space of time, at least three months, when the whole would have to be replaced ; this alone would entail an expense of £40. Now the total cost of working 33 tons of scrap is £77 12s. + £8 5s. for original cost of scrap = £85 12s., which reduces the balance to £46. This would be further reduced by loss of tin in collecting and re-melting, which would be fully 5 per cent. = £5, which brings balance to £41, as against £92 7s. This figure worked out to 100 tons in place of 33 gives £124 4s. 10d. per week = £6,420 11s. 4d. This, though a good profit, after deducting for interest on capital and depreciation of plant would leave but little for dividends.

The profits of 30s. per ton on galvanising being merely an estimated one we will pass the same, though by no means agreeing with it.

Next we come to the refining of copper ; without going into details as to the cost of working, &c., we will simply mention that they have evidently left a 0 out when stating that 50 tons per week could be worked by two men ; the very lowest number of men required would be 20. This alone would decrease their estimated profit on copper by £2 per ton, and the depreciation of solution in the same way (as we have mentioned) as tin would be at least 7s. 6d. per ton, and other incidentals, say, 2s. 6d. per ton = £2 10s. per ton, which leaves only £2 10s. per ton profit in place of £5 ; the total profits would now be :

| | | | |
|---|---|---|---|
| Profit on tin per annum ... ... | £6,420 | 11 | 4 |
| ,, on galvanising ... ... | 3,750 | 0 | 0 |
| ,, on copper ... ... ... | 6,250 | 0 | 0 |
| | £16,420 | 11 | 4 |

or a little more than 10 per cent. on the capital involved, which would hardly pay for management and depreciation.

In conclusion, we will consider the capital, viz., £150,000. This amount would barely procure stocks to work with. In the first place to produce 50 tons of copper a week, a stock of at least 400 tons would be required ; this alone would swallow about £36,000 (including silver and gold in same), and to work as they propose four such works the stocks would be £144,000, almost their whole capital, and, in the next place four works would cost at least £60,000, which brings the total to £204,000, the same being sufficient, without going into cost of stock, for tin and galvanising, to show that their capital of £150,000 would be far under the requirements for the gigantic undertakings this company proposes.

**Doubters.**

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In the ELECTRICAL REVIEW for June 25th, 1886, appeared your graphic description of some of the difficulties encountered in trying to extract tin by electricity, and the same number also contained the notice of the formation of the above-named company with the names of some eight gentlemen, in addition to the inventor, who promoted or became directors of it, none of whose names, excepting that of the inventor, however, appearing in the new or extended company. In your magazine of November 19th, 1886, the official return states that 1,212 shares of £1 each were taken up, on which 15s. per share was paid, amounting to £966 15s., the further number of 25,000 shares being considered as fully paid. Again on June 17th of this year in your magazine it is stated that enquiries are being made for a copy of the balance sheet of this company by *Money* to see "what justification the directors have for issuing £5,000 in debentures as a first and exclusive charge ?" And you ask the managing director to give us "some information respecting the company's position ?" And the only reply seems to be the issue of the new prospectus asking for £110,000, and proposing to deal with three distinct forms of manufacture in zinc and copper and tin. Now, seeing that it is nearly 18 months since the company began, is it not due to those who are invited to entrust the said large amount in their hands, that some profit and loss account should be rendered of what has already been done? Allowing for the necessary delay incurred in the erection of plant, yet surely a statement of six months working might be given, and also some explanation might occur to elicit the reason why those gentlemen, including more especially Messrs. Veasey, who first undertook to work the ship, seem to have forsaken it to a man?

**Enquirer.**

### Electrical Students and Alternating Currents.

There is no doubt that every student of electrical engineering is very much indebted to Mr. Swinburne for his articles on electrical measurement appearing in the REVIEW. Many points have been noticed which are not to be found in any of the so-called text-books, but of which a description and explanation has often been wanted. The beginning of the section, however, on alternating currents must puzzle several of our embryo electricians. In a technical college the syllabus usually does not include the practical theory of transformers and alternate current machines, though the pure mathematical part of the subject relating to coefficients of self and mutual induction is hurriedly gone over. The question is often asked, and is very seldom answered: "What course of study is necessary to obtain a thorough and correct knowledge of the theory of construction of alternate current systems of electrical distribution." Where, for example, is a paper which would enable a student to understand the theory and design of a transformer to give a certain output? It is a pity that while the easy and interesting part of electrical technology is fully treated in the establishments for training electrical engineers, the part presenting most difficulty, and of which a student, in general, has the haziest notions, should be left to be grappled with in private study. A gentleman well known in scientific circles lately said to me: "Nothing is easier than the elementary and advanced stages of electricity and electrical engineering; it is only when we come to currents which vary from instant to instant, that any real difficulty crops up before the student, and here, alas, least help is given him, and he is left to grope in the dark as best he may." I wonder, for instance, how many of our advanced or honours students understood the article in last week's REVIEW to which I have already alluded. No set course of study or progressive articles on this subject seem to be in existence as they are in other branches of the science. I have found these difficulties, as I am myself a

**Student.**

### Parliamentary Powers for Telephone Companies.

I notice in your issue of the 16th inst. your reference to the United Telephone Company in petitioning Parliament for extension of its powers. I think there can be very little doubt indeed that if the full benefit of the Telephone Exchange system is to be had by the public, it can only be when the different companies have as much parliamentary powers as will enable them to fulfil that end. From time to time in your Journal and elsewhere we see that there is a deep rooted feeling of discontentment causing much complaint against the operations of the telephone company in London, but we in the provinces would like to remind you that with us it is not so. I have been a subscriber to the National Telephone Company in Glasgow for years back, and cannot call to mind any cause we have had to complain of its actions, or of the service we get, leaving out exceptional cases. From the office here I can, and often do, communicate with my clients all over the west of Scotland, as well as into town, with regularity and ease; but one day lately I wished to communicate with a town 30 miles distant, and found something was wrong. On inquiry I found the cause to be that a land agent, representing a proprietor, had refused to allow the telephone company to lop off some branches of trees that were overhanging the public road, for which the telephone company were paying the road trustees for permission to erect the poles and wires; but seemingly there was no power by which they could get the branches of these trees removed, and in consequence they had to alter the line for about a mile, causing trouble to all, as well as considerable unnecessary expenses, and I was told at the time that such is only one of the many like cases the company have to meet from time to time. Some time ago, in a suburb of Glasgow, a line of poles, nicely ornamented, square, painted near the bottom, and varnished above, were, with authority from those in charge of the roads, erected, and several houses were to be joined to the Telephone Exchange system; but some of the proprietors in the vicinity objected to the poles being placed opposite their property, with the result that they had all to be taken down, and those who wanted to have telephonic communication had to do without it. Now it is well known that the Telephone Exchange is a public institution no town can pretend to do without, and consequently we subscribers are the real sufferers, as no doubt the telephone companies will keep up their rates, so as to give them some return for their money, and still if matters were made easier for them, there is reason to hope that the rates would be lowered all round. In Glasgow, last year, they were lowered to all subscribers from £20 to £15, and this irrespective of existing contracts at £20, and of course we think the company will more than make it up in the increased numbers that will join, and in the goodwill and assistance they will receive in consequence. We in the provinces would therefore think that if the companies working the provinces are to be benefitted by any legislation granted to the United Telephone Company as the mother company, that all assistance should be given them, however unpopular they may be in London, as there can be no doubt that if thoroughly ventilated and understood the shareholders of the United Company will see to it, and that they will not continue to stand in their own light as well as perhaps hinder others from receiving what they should reasonably expect. I am not aware what powers the telephone company are asking for, but doubtless amongst them will be power to stretch wires across property, and if we are to have overhead wires (and I fear few are prepared to pay for underground wires), then the telephone companies should have such powers as would prevent the unnecessary obstruction of people who claim that all under and over their property is theirs by right. It would seem, from what has already been done in erecting lines of wires in all our towns and cities, that the objection to them is not serious, and is only from obstructive people who take it into their head to do so. On the other hand, it would never do to allow the telephone companies to erect and attach poles and wires when and where they like; and it would seem that the proper way would be for the Government or the municipal authorities to appoint thoroughly practical and trustworthy inspectors to arrange between the telephone companies and the proprietors, these officers to be guided by rules and regulations laid down by Parliament, who are not, of course, in power to do it in detail until a commission has visited and gone into the details and taken evidence in all our large towns and cities. Our Government could well afford to pay for such officers out of the large revenue they are receiving from telephone subscribers through the telephone companies. There are many points of detail that would require consideration, but I think if telephone subscribers are to go on paying the heavy royalty they are now doing to the Government, it is only right that they should receive such special consideration in the way of legislation as would give them some return for it, without unduly interfering with the real existing rights of others.

**A Glasgow Subscriber.**

### What is the Cause?

The numbers of birds found dead along the route of telegraph wires, &c., are, as a general belief, supposed to be killed by coming into violent contact with them while flying. This is, no doubt, in a very large number of cases true, especially during the shooting seasons when the birds are badly scared; but from what has come under my personal observation of late, I am doubtful as to it being always the cause. The circumstances were as follows:

Within the last month several small birds were seen on different occasions to perch on and then fall from a 19/12 bore cable, carrying a 20-ampère current charging accumulators.

At first I was doubtful as to their being killed by the current, but as a cable of this size could scarcely fail being seen by a bird, when we consider their proverbial keenness of vision, and from the position of the cables, which are suspended along the face of a building from brackets, it was not reasonable to suppose that they had flown against them accidentally and injured themselves, and on examination this was supported from the fact that there were no bones broken or feathers displaced, nor is it likely they selected this spot to die from natural causes.

On the other hand, they could not possibly short-circuit the cables with their feet, as they are 9 inches apart, and it seems incredible that the difference of potential in the short length of this cable between the birds' feet, probably an inch, could be sufficient to cause their death; but such is apparently the case. It would be interesting to learn if similar instances have been observed.

As this may interest a number of subscribers, I trust you will find a corner for it.

**R. D. Smillie, M.S.T.E.**

Dumbarton, N.B.

### Metallic Circuits for Telephone Lines.

I have read with interest the above article in your issue of the 2nd inst., and as I cannot agree with some of Mr. Bennett's objections to the twist system, and his idea of remedying the faults peculiar to it, I crave space to make a few remarks thereon. I am quite of opinion that the spiral system of running metallic circuits is to a certain extent open to objection, but not to such an extent as Mr. Bennett would have us believe. He mentions six objections, some of which are admissible, some trivial, while others are applicable in a greater degree to his plan. He first of all finds fault with it from a financial point of view, asserting that the twists are more costly to erect and maintain than straight wires. This I question. There is no more expense incurred in running wires on the twist than on the straight. There is no additional cost for material or labour. A squad of good workmen will erect a given length of wire as quickly in the spiral form as in the straight, and in less time, if the latter requires to be crossed. It does require more care, but care is not an expensive item, while it acts beneficially on the work and has an educative influence on the men. As to the comparative costs of maintenance, there being a greater liability in the twisted wires coming in contact, they require a little more attention, but the extra expense resulting therefrom is not so great as to necessitate a new system. I believe that if Mr. Bennett were to compare the cost of construction of the new and old systems he would give preference to the latter. The plan he has developed requires more insulators, brackets, and G.P., while there would be extra labour in fixing them as well as in jointing and terminating the lines.

I do not put much stress on his second objection, that the difference of level in the twisted wire is a source of weakness. It is to a very small extent, but I would ask him if the twisting of a wire round itself in terminating is not a greater cause of insecurity. By taking 1 foot as the difference of level in a span of 65 yards, we find it to equal 1 in 200, so small, indeed, that the angle it makes at the insulator—which I presume Mr. Bennett refers to—and its increase in the length of the span may safely be neglected.

I would only say in connection with his third or æsthetic objection, that straight wires out of regulation are further from being things of beauty than twisted wires in the same state, and both are not particularly long in acquiring that state. There is something in his fourth objection, though from experience I find that twists do not readily come in contact unless the lines be badly out of order.

The difficulty he speaks of in altering an established route of twisted wires is quite true, but I would ask, is Mr. Bennett's system free from the same difficulty? If on one of his new routes a way-leave be withdrawn—which is not an unlikely occurrence—necessitating in the shift an increase or decrease in the number of spans, would this not disturb the balance of the sections and require their re-adjustment?

His sixth objection refers to a difficulty which most linemen at first experience when hunting for a contact on the twist; but I am informed by a competent practical man that it is not absolutely necessary to walk beneath the wires. If the faultsman on walking at a distance of from 5 yards to 20 yards from the poles will slightly stoop when he detects anything suspicious, he will observe the opposite angles made by the intersection of the two wires to move, showing them to be clear. I believe greater difficulty would be experienced in looking for a fault on Mr. Bennett's wires. The faultsman would not feel satisfied unless he had examined all the G.P. connections, which he could only do by ornamenting the poles with the spur of his climbers, by carrying a ladder, or perhaps by patrolling the route on stilts.

I would now mention some other objections to the new system, and there are some. I have already given it as my opinion that it would be more expensive, while from a mechanical point of view it would be less stable. From the appearance of the shackles as illustrated in the article I believe they will have a tendency to give way to the strain on the wires, causing a tension on the G.P., and probably a disconnection. This giving way of the insulators might, however, be a blessing in disguise, as it would obviate the necessity of using Mr. Caw's tension regulators.

Electrically, the crossing system is also faulty. The use of the G P. is open to strong objections; besides the ordinary objections, it runs the risk of being injured by the feet of the linemen when working on the poles. The great increase in the number of joints renders it also weak, while the addition of so many insulators would be an intolerable nuisance. It increases the cost of construction and decreases the insulation, especially when the brown earthenware insulators are used, and each shackle would facilitate the mutual leakage between the two legs of a loop. For instance, the "27th" loop would be, unfortunately, in the possession of as many insulators as a twisted one double its length, and would have about as much leakage.

I hope the telephone companies, for their own credit, will abstain from running "27th" loops; the subscribers would not like them. I am afraid if, after dropping in my sixpence or sticking up my toll stamp, I found myself at one end of a "27th" loop endeavouring to transmit my thoughts to the other, my innumerable "Hilloas" might be interspersed with words expressly forbidden by the companies' moral law.

Mr. Bennett says the twist answers its purpose admirably, even perfectly, while I am doubtful if any telephone engineer could be found to similarly compliment his system. I am inclined to think that we must not forget our old friend Micawber, but wait till someone "turns up" a method of killing induction on single wires. A name, fame, and fortune awaits that lucky individual. Till then we should, as I now subscribe myself,

**Let Well Alone.**

*December 14th*, 1887.

By his treatise on telephone loops and circuits, Mr. Bennett has shown what, in his opinion, are the advantages to be derived by using cross connections on telephone loops, also his objections to the practical use of twist.

Generally speaking, a heavy trunk line on the twist system is to a certain extent unsightly in the eyes of non-practical observers, but to anyone who is experienced in the use of such circuits it can be seen if the wires are properly regulated and terminated. As Mr. Bennett has stated, the running of a heavy line of perhaps 12 or 16 loops does require care, also ability, the more so if the four-wire arm be used, and every two arms carrying four loops, as can be seen in some routes in the western districts, where some of the most heavy and efficient telephone circuits are in use, being all on the twist principle. Mr. Bennett has made mention of faults not being so easily traced on lines run with the twist. Any lineman who is thoroughly acquainted with that system can as easily detect a fault as on wires run straight, without confining himself to walking direct under or close to wires. If at any crossing or intersection of wires he may think a fault to be, he, by slightly stooping, will see (if not any fault) wires separating or joining, according to his position, at a distance of 10 to 15 yards quite as clear as walking under.

Mr. Bennett thinks regulation cannot be got so well. It so happens that with the twist every second span alternately is run straight, offering no objection to regulation; but on the other hand, where wires are run straight through, the least item of non-regulation clearly shows, and in the end makes a much more unsightly line. Another of Mr. Bennett's objections is extra time required to construct a line with twist. By the ordinary way of running wire there can be but little difference, as one man on the twist principle can draw out and hang up a wire (if light wire be used), and no more can be done on the straight run style. Then as to more wire required on lines with twist, does Mr. Bennett take into consideration the extra quantity required for lines constructed on the cross connected system? If so, it will be found that a greater number of terminations require a greater quantity of wire, also extra insulators for shackling purposes, making in the end a line taking up more time, greater amount of workmanship and material, showing less insulation and more resistance than lines with the metallic twist used.

It is a well-known fact that in tracing a line for faults, the open connections are preferable to G.P., and by Mr. Bennett's system, before a line could be thoroughly examined, all connections must be seen, creating a loss of time, the more so the greater the number of connections.

There is one noticeable fact in connection with the running of twisted loops which, if acted up to, will serve in the end to be beneficial if four-wire arms be used. The general way of running twist is on each side of pole spirals are reverse, throwing as it were the sides of loops into company all the length of the line, whereas by running spirals with the same nature of screw on either side of the pole, it will be found that no two wires keep on a line any part of the distance, let there be as many loops as even 27.

**Lineman.**

### Compound-Wound Dynamos.

In your last number I am pleased to find my brother, S. A. Varley, is trying to liberate the trade from what I believe is one of those cases in which the law is used for oppression instead of liberation.

If anyone will take the trouble to examine the stores of many of the large telegraph works on the Continent and in England, they will find numerous compound-wound electrical magnets for telegraph purposes, and therefore if anyone in a patent specification adopts an electro-magnet without expressing the particular kind of winding, I cannot conceive but that it embraces the whole of the various modes of winding. But as the next misfortune to losing a lawsuit is the gaining of one, and as the trade, like myself, would like to avoid the waste of time and anxiety, I should recommend them to do as I did for the Pilsen-Joel Company's dynamo which I constructed for the ss. *Thistle* (and which has been spoken of as a great success), viz., I wound two of the four field magnets with thick and two with thin wire, using the former as series and the latter as shunt circuits; or wind one end of the core with thick and the other with thin wire, and this I have proved in practice will answer equally well with or even better than the usual compound winding, inasmuch as you can remove or add wire easily and so get the final adjustment.

I have had, like my brother, very great experience in the manufacture and construction of all kinds of electrical apparatus, including the designing of several forms and the construction of between 200 and 300 dynamos for electric lighting and depositing metals, and consequently feel strongly upon the subject in question.

**Theophilus Varley.**

*December 15th*, 1887.

It is only courteous to Mr. Sellon that I should notice his letter which appears in your Journal. He has informed us that there is a river in Macedon and another in Monmouth. That being so, I contend Englishmen should be allowed to drink freely of the river which flows at their feet without being called upon to pay tribute to Macedon for doing so. If Mr. Sellon will kindly credit me with intending no personal application in my remarks, I would say in reply to what he is good enough to call "Mr. Varley's well-known sense of self-abnegation," that Nature is sparing in her gifts; to some she gives the power to work, to think, and to originate; to others the power to talk, to adapt, and, I fear, sometimes to appropriate, and the latter description of people are not infrequently termed, in the common parlance of the world, men who have got their heads screwed on the right way.

If I have not been crowing at all times and asserting myself I do not lose my rights, and with reference to my nine years' silence on the subject of compound-winding, I think there is every probability that I should have maintained silence all my life if the Anglo-American Brush Corporation could only have been content with their undoubted right to manufacture compound-wound dynamos, and not have attempted to encroach upon what I consider to be the equally undoubted rights of their less assertive and more peaceably disposed neighbours. I have thought it my duty to speak at times somewhat strongly in the article now in course of publication, but I have the courage to acknowledge that I have a certain amount of sympathy with the Anglo-American Brush Corporation, for they fairly purchased their property in the faith that there was a good title, and I believe, had they also purchased the legal rights I held at one time, the claims they now assert would be unassailable; but, at the same time, I maintain also that automatic self-regulation was not considered to be in the bargain, either by the buyer or the seller, when the Anglo-American Brush Corporation acquired the patent rights of Brush.

**S. Alfred Varley.**

*December 17th*, 1887.

### Electric Light in Towns.

Will you kindly inform me in what towns in the British Isles the electric light is used for street lighting, and where it has been tried but discontinued.

**T. E. Stinges.**

Bath, *December 16th*, 1887.

[The information required by our correspondent is more than we can compile at this busy season of the year. Perhaps some of our correspondents may be able to give him the information he desires.—EDS. ELEC. REV.]

### The Measurement of Alternating Currents.

Mr. Swinburne is apparently brooding over the subject of alternating currents and their measurement. Let us hope that something will be hatched. I cannot say, however, that his article in your last issue appears to get us much "forrader."

His intrepid onslaught on the mathematicians and the "German periodicals" is refreshing, but then comes the ha'porth of bread in the advice to use a wattmeter, which, "assuming there is no self or mutual induction, measures the power."

Now, I venture to think the ordinary electrician will get on with his installation very well without the aid of this *rara avis*, which, somehow, one never sees practically used.

Does Mr. Swinburne mean that the electrician is to borrow his engines and dynamos in order to trot out his wattmeter, and having determined the power required to the last watt, then to lay down his plant to correspond? I do not fancy this practice will become general.

Or does he expect his fireman to carefully inspect the wattmeter before adding on a shovel of coals? The watts on any ordinary installation are of course constantly altering, and the best practical integration of them is given by the coal bill. There is one thing, however, which must be kept as constant as possible, and that is, the temperature of the lamps.

Mr. Swinburne let fall some observations on this point at a recent meeting of the S.T.E. & E., which I should like to see in print. I gathered that he considered incandescent lamps twinkled with alternating currents.

I do not believe this. If the alternations have a period of anything like 10,000 to the minute, I believe the variation of external temperature of the filament of even a 16-candle lamp to be quite inappreciable, and the flow of heat from it to be an exact measure of the power spent in it.

He also seemed to think that voltmeters on my principle would not give correct indications of the temperature of lamps on alternating circuits. Has he ever tried it? It is easily done. Take two lamps, measure their C.P. against each other, first on cells, then transfer one lamp to an alternating circuit, giving an equal potential difference, as shown by one of my voltmeters, and test the C.P. again.

For further information try the same test with a dynamometer.

**P. Cardew.**

### Electrical Belts.

Seeing a "Wonderful" Electrical Belt extensively advertised by a manufacturer who styles himself an "Eminent Consulting Medical Electrician," and who occasionally takes a whole page of the *Telegraph*, *Standard*, or *Daily News*, for the purpose of making known to suffering humanity the many virtues of his marvellous discovery, I must confess that I did not believe such astonishing statements were wholly unreliable.

Thinking that one of those "Electropathic" Belts would just suit my case, I sent a P.O. Order for three guineas, and received, not an electrical belt, but a thing which I should consider dear at five shillings. I showed it to an electrical friend, whose knowledge of the science is unquestionable, and he solemnly assured me that I might as well have pitched the money into the gutter. The belt, he said, if joined up with the most sensitive testing instrument known to the profession would not show a trace of electricity.

I immediately returned the belt and demanded my money back, but the man refuses to refund my three guineas, and I, therefore, write to you, sirs, knowing that in the interests of the electrical profession you will not allow this to pass unnoticed.

I have made enquiries as to the qualifications of the manufacturer of this wonderful belt, and I find that he is only known to the profession as an advertiser whose success appears due to the credulity of the suffering public. I enclose my name and address, and also the name and address of the man to whom I refer.

**A Poor Victim.**

### The Telegraph-Engineers and Electricians' Conversazione.

I am instructed by the President, Sir Charles Bright, to request the favour of your permitting him to express through your columns his great regret that so many of those gentlemen who favoured Lady Bright and him with their company at the reception at the Institute of Painters on Thursday evening last, should have experienced so much inconvenience by the unfortunate breakdown of the arrangements in the cloak room.

The space available for the deposit of hats and coats is certainly very limited at the Institute, but the accommodation provided and the number of men engaged, was the same as upon the occasion of Professor Hughes's conversazione held at the same place last year, and as no confusion then occurred, there was no reason to anticipate any last Thursday.

Mr. Hart, the resident porter and doorkeeper at the Institute, who had, as before, the immediate charge of the arrangements, attributes the occurrence to the circumstance that so very large a number of visitors arrived almost simultaneously at one period of the evening, that it was practically impossible for him and his assistants to deposit the coats and hats in their proper numerical order; this, of course, led to some delay in giving the coats and hats out, and some of the more (not unnaturally) impatient visitors then insisted on going behind the barriers to find their coats themselves; from that moment confusion reigned. I myself hastened on the scene immediately I was informed of what was occurring and endeavoured, with only partial success, to persuade those gentlemen who had forced their way inside the barriers to retire and leave the attendants to perform their duty as well as the state of things would permit.

**F. H. Webb,** *Secretary.*

Society of Telegraph-Engineers and Electricians,
London, *December* 21*st*, 1887.

### Trade Catalogue Piracy.

Seeing, in the last issue of your Journal, your observations with regard to the unscrupulous piracy of trade catalogues by those wishing to profit by the work of other people's brains, we shall feel greatly obliged if you will allow us to make a few remarks, lest, as you pertinently state, we may be judged to be copyists when, as a matter of fact, we have been victimised just in the manner described in your notes.

Four years ago we published a catalogue, succeeded a few months since by a new edition, in which edition a great deal of the same matter appears again, and some in a precisely similar form as before. It has come to our knowledge that this old catalogue, which we omitted to register, has been largely copied by a firm who have not scrupled to cut out page after page, sending them to their printer to be set up as original matter, embodying them into their own catalogue. Our new edition, which we have taken the precaution to register, was issued a few months before the above-mentioned copy, and it seems to us that the matter extracted is as much taken from the registered as from the unregistered edition.

It would be interesting to know how far a printer is culpable when he is aware that he is setting up matter which has been taken from another catalogue, which he himself may, or may not, have actually printed.

We do not desire to trespass further on your space, and should not have troubled you with these few remarks but for the reason before stated, that we wish to avoid being considered mere copyists, incapable of compiling an original catalogue.

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